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The Coal Situation

"TAG, you're it!" fits the coal situation admirably. "Coal shortage is imaginative and leads to hysteria," say the jobbers. While the producers blame the wagon mines and the railroads, the railroads in turn disclaim any blame for lack of coal production. Out of it all stands clearly the fact that many sections of the country are short of coal and this is proved by its high cost. Were markets amply provided no such prices as now obtain would be asked for fuel. True, the general situation is not as bad as it was, but it is far from comforting, and electric light and power companies will keep up their fight for supplies for present consumption and for storage. Promises cannot be burned under boilers or be converted into electricity, and the utilities are obligated to furnish service to their respective communities and mean to carry out their end of the bargain. Coal they must have for that purpose and they will not be content with anything else.

Self-Interest in Financing Utilities

THINKING of an inspiring kind found voice at a recent convention of California bankers when one of their number advanced as a reason for direct investment by banks in public utility securities and for recommending their purchase to patrons the self-interest that bankers have in thus promoting the development of the state. "What of it," exclaimed the speaker, "if you can buy some other security that will pay you a little higher return or yield you a little more profit? The difference in yield is nothing compared with the tremendous direct benefit you will get from the development of the state." The spread of this idea will place the stability of public utility investments on the same fundamental basis on which it is generally conceded that electric service everywhere rests.

Regulation in Michigan

THE latest evidence that the problems of the public utilities are gradually becoming understood in high places comes from Michigan. The public service commission law in that state has been operative only a little more than a year and yet Chairman Smith of the Michigan Public Utilities Commission has managed in that short time to comprehend the situation rather fully. From the facts in his possession he concludes, like Commissioner Edgerton of California, that over and above the ordinary rate of return necessary to keep a utility in an operative condition there must be some reward for efficiency, as well as a surplus to safeguard it against the day of adversity. What comfort such a public utterance must bring to the utilities of Michigan, and yet unless the justice of Chairman Smith's position is understood by all it will avail nothing. Hence the necessity of telling the people the truth about their public utilities so that they may judge aright of the need of close co-operation and harmonious action between the utilities and the commission so that both may merit public esteem. Service, after all, is what counts, and it wins more friends than all the honeyed words of the demagogue or the propagandist.

Popularizing Interconnection

WIDESPREAD publicity of the advantages of a "super-power" trunk line along the north Atlantic seaboard has created a lively interest in the subject among engineers everywhere, and especially among those who previously appreciated the benefits of interconnection even on a modest scale. It would be a mistake, however, to assume that the general public knows much about interconnection at this stage of its development. For this reason, there is an opportunity for intensive educational work during this fall and winter by public utility men. It is interesting to note that such a plan is proposed at Haverhill, Mass., where the local Chamber of Commerce expects to call upon technically qualified speakers to address that body upon the meaning and benefits of the super-power and lesser interconnection schemes. The co-operation of local central station men and of the industry generally with these organizations of alert and progressive business representatives offers a means of making clearer one of the great economic movements of the day and setting forth more effectively than could otherwise be done the aims and ideals of modern electric service.

Technical Education

IN A few weeks our technical schools will throw open their doors to thousands of returning students. Youth, ever impulsive and enthusiastic, seeks knowledge and under proper guidance can surmount many difficulties. But there are handicaps which no student should be called on to endure in a country like ours. By that is not meant shortage of equipment, valuable as apparatus is. The lack of competent instructors is far more serious than any dearth of equipment, and on that score many of our smaller institutions of learning have suffered grievously. Society in general and industry in particular is a loser whenever a technical graduate is not adequately and properly instructed. Therefore, the industry which seeks or uses graduates in engineering has an interest in their general proficiency and should see to it that funds are available for the best instructors obtainable. Indeed, much of the money spent by manufacturers in shop schools of instruction could be employed to better advantage in our institutions of learning, which are designed for that purpose and no other. Teaching is an art by itself, like manufacturing, only it lacks commercialism, and the community which rates its tradesmen above its instructors is hopelessly lacking in discernment.

Protecting Parallel Transmission Lines

TWENTY years ago a relay was almost invariably an electromagnetic device used in telegraphy for increasing the strength of signaling current in a local or secondary circuit. In recent years, however, the term has come into application in telephonic, radio, chemical, lighting and power circuits, so that it is of much broader meaning than formerly. Protective relays are now extensively employed in power stations and substations to isolate disturbances.

An interesting type of protective relay is described in this number by E. R. Stauffacher, who refers to an application where two three-phase transmission lines run in parallel from station to station. Current transformers in the phases of these lines operate differential relays in such a manner that if the system is normal the current divides in definite proportions between the two lines, but if a short circuit occurs on one line the balance will be destroyed. The relays then actuate in such a manner as to disconnect the faulty wire or wires at each end.

As power-transmission systems grow and interchange energy the task of the protection engineer becomes more complex and difficult. We may expect to see an increasing number of protective devices come into standardized service.

A Much Mooted Question

IN recent issues we have reverted to the much-mooted question of oil as a central-station fuel. As between oil and coal the situation is, in fact, one of balance, since the prices of both fluctuate in their upward drift. The price of coal at the shaft is rising moderately, that at the bunker immoderately. A recent analysis of the situation indicated that in one way or another the middlemen were getting a large and increasing proportion of the difference. Transportation, too, is a serious item and may be yet worse in the future. How far it is linked with the working of the sales mechanism remains to be seen. As to oil the situation is different. It comes via pipe lines or tankers from sources which are under somewhat unified management, and its price shifts according to no laws that can be predicted. When the price for B.t.u., is down it becomes a most useful fuel, owing to its collateral advantages, which are set forth this week in our article on the subject. The decrease of smoke, the reduction of boiler-room labor, the freedom from ash-removal tell heavily in any comparison on a practical basis, as also does the advantage of ease in pushing the fires in case of need.

As to the actual boiler efficiency attained, there is wide difference of opinion, since the results obtained with coal fired in modern stoker-equipped plants leave littla to be improved upon. Leaving thermal economy in abeyance, the oil has the best of it in some important particulars. Not the least of these is the easy storage of fuel oil in concrete or steel tanks in large quantity near the station. Such a fuel reserve is of high importance in these troublous times. The relative ease of operating oil-fired boilers is attractive, but whether the unions would permit the operation of ten boilers by one fireman may be open to grievous doubt. There are rather attractive features in a combination of coal and oil firing under favorable conditions, as a refuge in time of trouble, some of which have been published from time to time in the ELECTRICAL WORLD.

When it comes down to the final analysis of the situation, the vital factor is one that belongs to the totally unknown; that is, the future course of the relative prices of coal and oil. If rumors of foreign deals are true, there is no very cheerful outlook for modest prices for fuel oil, especially if a swing toward oil firing in many plants should occur. The only operator who is really safe is he who has a contract for oil long enough and at a price low enough to permit him cheerfully to scrap the whole oil-burning outfit at the end of the term. Otherwise he may or may not find the experience really profitable.

Modern Tendencies in Cable Construction

A VERY suggestive summary of modern tendencies in cable construction was recently noted in our Digest section. Much of the experimental work on the subject has been done abroad, where from the greater proportion of urban requirements the use of cables is relatively greater than here. As the author of the paper in question fully appreciates, when transmission distances lengthen and higher and higher pressures are reached, aërial lines are increasingly important, and their use abroad is very materially extending. It is curious to note the attempts at compromise by conductors carried in troughs on solid insulators and packed in compound. A few such were made here in the very early days of power distribution, but were soon given up, as seems to be the case abroad, in favor of cables. Electrostatic capacity and dielectric hysteresis are and will continue to be dominant in high-voltage transmission by alternating currents.

The general principles of cable design and construction have been well established for more than twenty years, and the most considerable change in practice has been the rapid increase in the use of impregnated paper insulation, especially for the higher voltages. Vulcanized bitumen, which seems to have come into considerable use in England, is much less well known elsewhere and is hardly in the running at anything but moderate pressures. Jute is little used save for an exterior serving, and rubber, excellent in some circumstances, is rerely used now at the higher pressures, even as the phrase would be used in English practice.

As regards the arrangement of conductors, there has been but little change for a long period, owing to the fact that the earlier workers knew their job well. Conductors of segmental section have some obvious advantages but have not yet obtained a strong grip on the art. The chief modifications in late years have been in the direction of incorporating in the structure one or more pilot cables for protective purposes or splitting the main conductors into pairs, commonly concentric, to serve a similar function. Such cables are of considerable service in distribution work and have been adopted in some American stations with excellent results.

The insulation applied to the conducting system has not changed radically in recent years, save as it has gradually been thickened to resist higher voltage. The most significant advance has been in the grading of the insulation to lessen the electrostatic gradient. We cannot agree that this is only of theoretical importance. Those who are dealing only with modest distribution pressures may not feel the need of it, but if the time

comes when cables are to be used for important transmission work, the electrostatic gradient will become a vital factor in the problem of economic design. Even now the same matter must be taken into account in the installation of the insulator strings of a high-voltage overhead line.

Professor John Perry, F.R.S.

IN THE death of Prof. John Perry on Aug. 4 the technical and scientific world has suffered a serious loss. Though he had reached the allotted threescore years and ten, he had not lost interest or activity in his scientific work, and the energies of his last years during the war were devoted to his country's service, particularly in the development of the gyrostatic compass.

Educated in Belfast, finally at Queen's College, he early showed distinguished ability and presently was appointed assistant to Sir William Thomson. At five-and-twenty he was one of the little group of scientific men called to Japan to build up technical education there. It was a fortunate chance that thus brought him into contact with his long-time friend and colleague Professor Ayrton, with whom his name is instinctively associated by every electrical engineer. Together they plunged into a series of distinguished investigations on electrical subjects, which were communicated mostly to the Royal Society and brought the authors well-deserved fame. Sir William Thomson's comment was that the pole of scientific research had shifted to Japan.

Returning with Prof. Ayrton in 1879, the active career of the friends in the development of electrical engineering was continued, and together they laid the foundations of the Finsbury Technical College, one of the most notable engineering colleges in Great Britain. He stayed at Finsbury until 1896 and then became professor of mathematics and mechanics in the Royal College of Science at South Kensington, in which his later and important educational work was developed. Prof. Perry's mathematics were those of the engineer rather than the mathematical investigator. He was possessed of extraordinary intuition, the true spirit of the engineer, and he brought to his teaching a rare enthusiasm for dealing with concrete matters in an intensely practical way. He brought a new light to the mathematics of technology and his book on the subject was a masterly one which made a strong impression on technical education in many countries. It was in his ability as a teacher of sound principles that his greatest contributions to engineering rest, and more and more in his later years his energies were devoted to a work of instruction which has meant much to the development of British applied science.

Personally he was a man of most lovable and interesting character. Those who had the pleasure of his acquaintance well remember the alertness of his mind, the breadth of its sweep, his keen sense of humor, and unvarying friendliness to the young engineer who came in touch with him. He was most active in the meetings of the British Association for the Advancement of Science, of which for a good many years past he had been the general treasurer. In close touch with all scientific advances up to the very end of his life, his career was a most distinguished one, and his example of unswerving fidelity in search of the truth should be a lasting stimulus to the engineering profession.

Data on War-Time Central-Station Activities

A COMPREHENSIVE review of the status of the central-station industry during one of the most intensive periods of the war has just been published by the United States Census Bureau as a part of that Bureau's 1917 Census of Electrical Industries. The next regular five-year survey which is scheduled to be taken in 1922 will form, in conjunction with the census just published, an authoritative picture of central-station activities during periods of war rush, and peace-time production. The present report, a review of some of the most interesting portions of which will be found in the following pages, covers central-station operations from several angles not heretofore included in any survey of the Census Bureau. Among these is the distribution of the output for lighting, power, other public-service corporations, plant consumption and line losses; output generated and purchased; income from light and power customers; and data on fuel consumption.

One of the most striking phases of the analysis of the tabulations is the excess of municipal over commercial stations in some eight states, and the fact that the average rate secured by municipal plants was much higher than that charged by the private utilities. The increase of 756 municipal plants as against 565 new commercial electric stations is not so remarkable when the fact is considered that these are mostly small plants serving but one locality, while one commercial plant may serve a territory embracing many separate municipalities. It is to be regretted that the Census Bureau did not include a survey of isolated or private plant electrical operations and motor installations.

Measuring Reflection of Walls in Situ

IN THE predetermination of the number, power and distribution of light sources for the proper illumination of offices and other building interiors much depends upon the reflection factors of the walls and hangings. Whereas a single lamp may give a good general illumination in a room supplied with red walls of good reflecting properties, a dozen such lamps may have to be installed in order to obtain the same illumination in the same room when the walls are dark and have poor reflecting properties. It is ordinarily necessary for samples of the wall covering to be taken to the photometric laboratory in order to determine the reflection factor of the material. In this issue, however, Dr. A. H. Taylor describes a form of portable reflectometer which can be taken into the room to be investigated.

The instrument as described is a modification of the integrating sphere. By an ingenious removal of a small spherical sector from the sphere, thereby leaving a round hole in its wall, the wall of the room is optically substituted for the wall of the sphere at this point.

One of the interesting by-products of the article is the evidence adduced to show that the reflection factor of a certain slab of magnesium carbonate is as much as 99 per cent. This is a surprisingly high value, but it is given as obtained in three ways. This reflection efficiency beats the electrical efficiency of large transformers, which we believe is a little under 99 per cent. We had supposed that transformers were unsurpassed in this respect.

John B. Fisken

Dean of engineers in the Northwest and a leader in A. I. E. E. and N. E. L. A. activities in that section, who as president of the Northwest Electric Light and Power Association will preside at its annual convention next week

LAST month John B. Fisken completed thirty-three years of service in engineering-construction, maintenance and operation of the central station properties that now make up the system of the Washington Water Power Company at Spokane. During this time he has been a leader in all phases of engineering and is regarded in the great Northwest as the dean of engineers. In the activities of the American Institute of Electrical Engineers he has always taken a prominent part. Particularly has his influence been felt in building up the Pacific Coast section, of which he was chairman last year. He was also largely responsible for the organization of the Spokane section, of which he was chairman in 1913 and 1914. In 1916 he was elected manager of the Institute, in 1919 vice-president and recently was appointed chairman of its sections committee for 1920-1921. Likewise, in the Northwest Electric Light and Power Association Mr. Fisken has been an earnest worker as a member of its hydro-electric and technical committee. This year he has served as its president and next week will preside at the annual meeting in Spokane.

Mr. Fisken was born at Helensburgh, near Glasgow, Scotland, Nov. 2, 1861, and received his technical education in Glasgow and London. He came to this country in October, 1886, and took up electrical work in Seattle, Wash. In January of 1887 he went to Victoria, B. C., with the Victoria Electric Illuminating Company, then to Vancouver, and in August, 1887, to Spokane, Wash., where he has since remained. He was first associated there with the Spokane Falls Electric Light & Power Company, then with its successor, the Edison Electric Illuminating Company of Spokane, and the Spokane Street Railway Company, and finally with the Washington Water Power Company, which absorbed the latter companies. A system is now operated which includes four hydro-electric plants, with a combined rating of 78,050 kw., that serve 684 miles of high-tension transmission lines and 700 miles of low-voltage circuits. For that company Mr. Fisken is now consulting engineer. His responsibilities have included those of superintendent of light and power until 1918, then chief engineer, succeeding Carl F. Uhden, until his recent appointment.

Current-Balance Relay Protection

Necessity for the Development of a New System of Relay Protection Where Duplicate Parallel Lines Are Operated Is Met by Current-Balance Relay — Has Proven Effective in Case of Line Trouble

By E. R. STAUFFACHER
Protection Engineer Southern California Edison Company

THE Southern California Edison Company has recently placed in operation a system of relay protection which has structural operating features not found in common practice in the protection of parallel lines. In brief this system consists of a balance between the currents in similar phases of the two parallel lines—the lines being in parallel at more than one point—and as the currents in the lines under normal conditions are equal, while under abnormal conditions they are widely different, there is a basis upon which the relays will operate satisfactorily.

To understand the need for this kind of apparatus reference must be made to the system wiring diagram (Fig. 1). From Kern River No. 1 plant to and through Castaic, Fernando, Macneil, Los Angeles No. 3, Newmark, Puente, Chino and to Colton substations extends a double 60,000-volt transmission line. This line is 175 miles (280 km.) long and is of No. 4/0 copper. The Kern River plant is of 20,000-kw. capacity and feeds into the line noted. In addition the following plants connect with this line: Borel, at Castaic, with 10,000 kw.; a connection to the 47,000-kw. Long Beach steam plant at Macneil; a connection at Newmark through Eagle Rock substation to the 64,000-kw. Big Creek plants; a connection at Newmark to Long Beach steam plant by means of two 60,000-volt No. 4/0 copper lines only about 20 miles (32 km.) long, and connection at Colton to several small plants totaling 15,000 kw., and also to the system of the Southern Sierras Power Company, through a 5,000-kw. frequency changer. This line is practically the backbone of the system, and when a complete severance of both lines of this transmission bus takes place the system is badly split and a long interruption is likely to occur before the load can be so adjusted as to permit synchronizing.

Before the installation of balance relays, the practice had been to operate the two 60-kv. lines in parallel at Los Angeles No. 3, Newmark and Colton. At other points the lines were not paralleled and connection was made to one line only. At Kern River two of the 5,000-kw. generators would be connected to one line and two to the other side. At Castaic the outgoing power would be on one line and the incoming power from Borel on the other.

The stations at Macneil and at San Fernando were connected at either one or the other of the lines. Under these conditions each of the substations was operating from only one source of energy. If a short occurred on the line at any point betwen Kern River No. 1 and Los Angeles No. 3, which is a distance of approximately

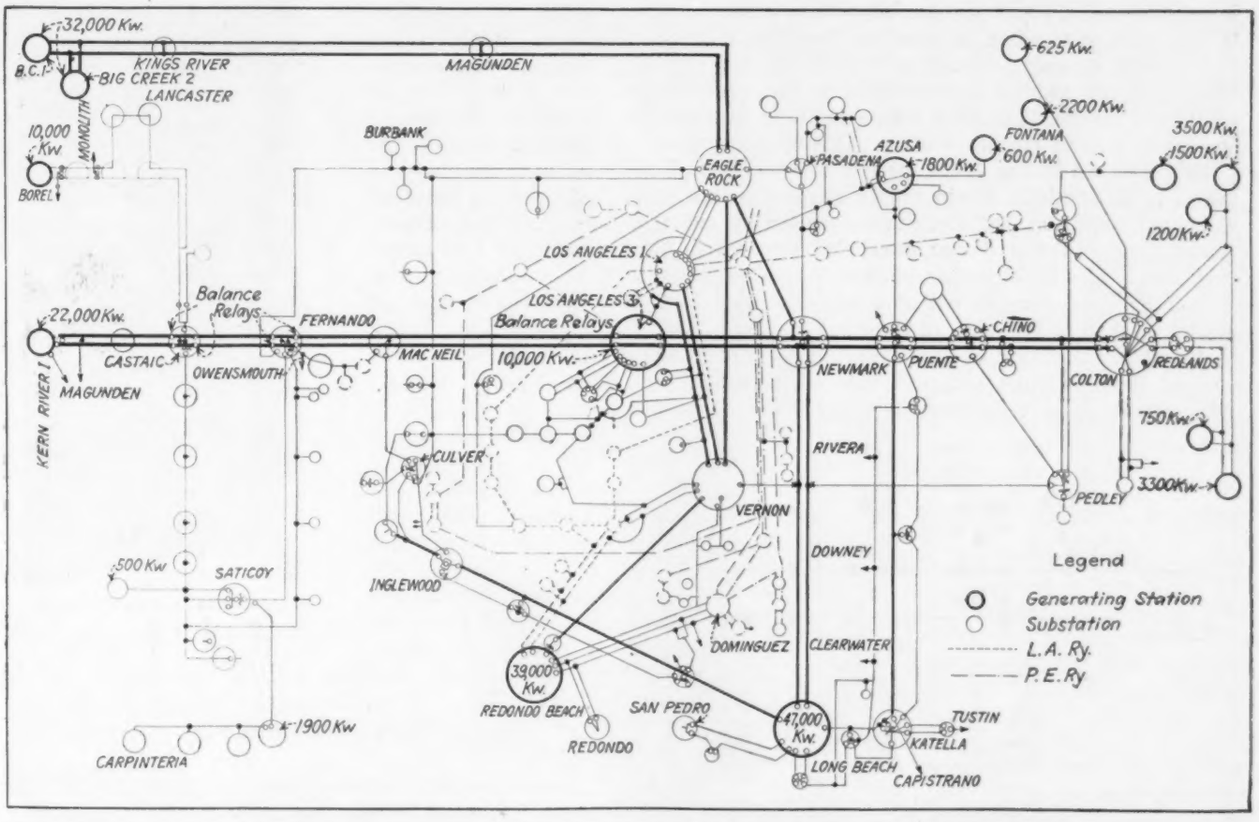


FIG. 1—SYSTEM DIAGRAM OF SOUTHERN CALIFORNIA EDISON COMPANY, SHOWING BACKBONE PARALLEL LINES

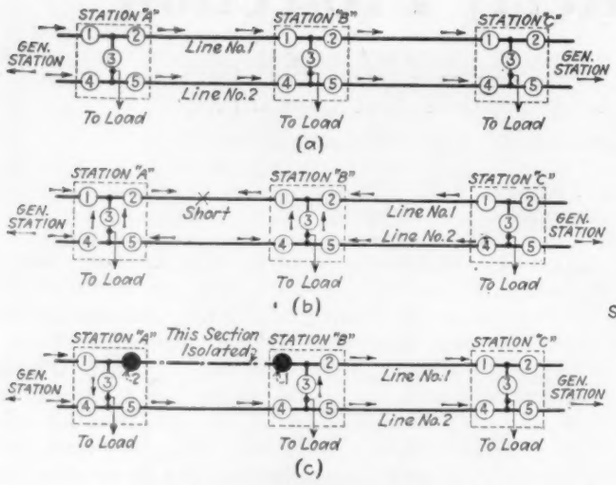


FIG. 2—BALANCE RELAY OPERATION

(a) Lines normal, (b) lines at time of trouble, (c) lines immediately after trouble is cleared. It is seen that only a section of one line is out of service.

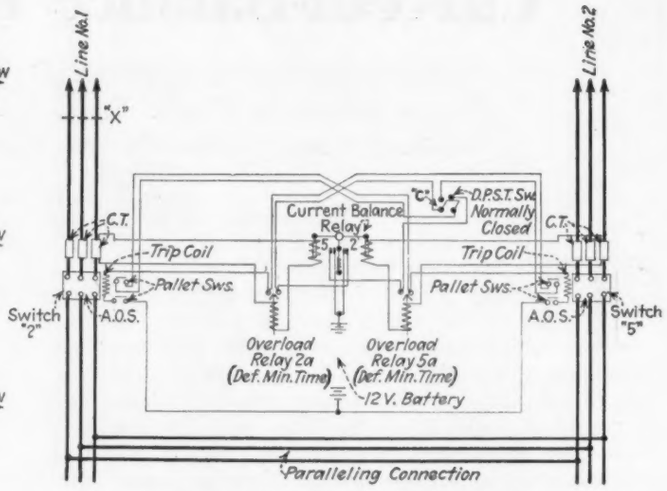


FIG. 3—SCHEME OF PARALLEL LINES PROTECTION IN ONE PHASE

It is only necessary to open switch *C* when one of the line switches has opened, and the operator is preparing to close this switch again to test the line.

117 miles (188 km.), these substations suffered an interruption.

When the balance relay scheme was put into operation it necessitated the operation of the Kern River transmission line in parallel with each of the stations mentioned. The equipment of the balance relays has been designed and installed so that only the defective section of the line will drop out upon the occurrence of short circuits. This gives the station a source of power from each of the four line sections entering the station. The relay operates upon the theory that in a grounded star system there will be more current in a phase which is grounded than in the same phase of the other line which is ungrounded. Provision has also been made so that in the event of one line in a section dropping out owing to a ground or short circuit, or if it is out for repairs, the remaining section is automatically put on definite-minimum, inverse-time limit relays and thus is protected in case of a short circuit in other parts of the system.

By reference to Fig. 2 the method of operation of the relays is illustrated. When the transmission line is in a normal condition, the circuits are closed by switches 1 and 2, and 4 and 5 and paralleled by switch 3 in each case. If a short occurs on line 1 between stations *A* and *B*, more current will flow through switch 2 in station *A* than in switch 5 in the same station.

A similar condition exists in station *B*, where more current flows through switch 1 than through switch 4. This condition of unbalance is utilized to operate the relays which will trip out switch 2 in station *A* and switch 1 in station *B*, thereby isolating the defective section of the line and preventing an interruption, as the total current can flow on the remaining line between stations *A* and *B*.

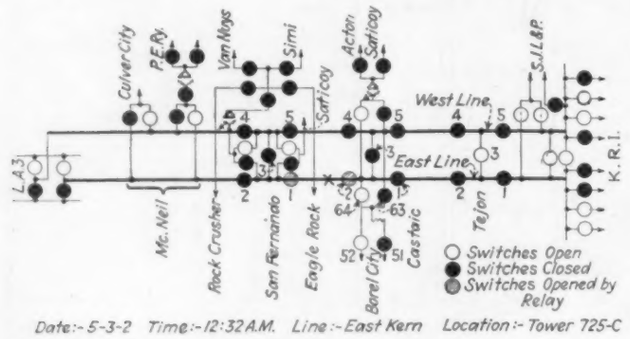


FIG. 4—TROUBLE RECORD, SHOWING ACTION OF SWITCHES

The balance relays consist of two similar solenoids mounted with their plungers suspended from the ends of a lever, similar to a walking-beam, as shown in Fig. 5. They were designed by the engineering department and built in the shop of the Southern California Edison Company. The solenoids are energized from bushing-type current transformers in the line oil switches. Referring again to Fig. 2, the current in phase *A* of line 1 is balanced against the current in phase *A* of line 2. This relationship is carried out with all three phases. When more current flows in phase *A* of line 1 than in phase *A* of line 2 the solenoid of line 1 will exert a stronger pull on its plunger than will the other solenoid on its plunger and so cause a deflection of the balanced arm, closing the relay contacts, which, in turn, will trip out the proper line switch. Fig. 3 gives the detailed wiring in one phase. The tripping current is furnished by a 12-volt Edison storage battery.

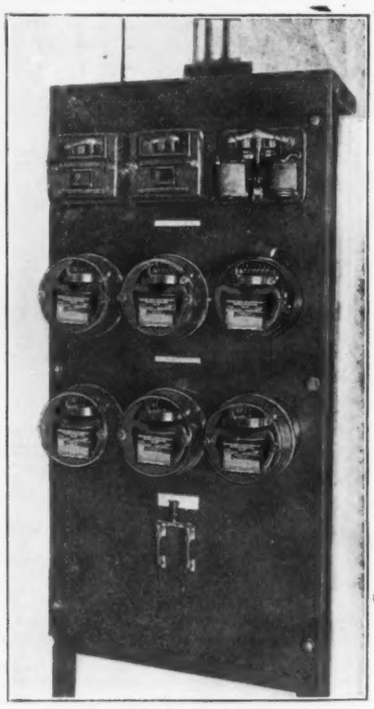


FIG. 5—TYPICAL RELAY PANEL

Current-balance relays above, inverse-time-limit relays below

These current balance relays have been in operation for about three months on a section of the Kern River line, the installation being made at Castaic, San Fernando and Los Angeles No. 3 substations. During these

few months of operation they have successfully cleared several shorts without interruption to the energy supplied by the transmission line.

These relays were installed to protect the transmission line against grounds or shorts on the line, but were not designed to protect against any trouble which might develop inside of the substation. There have been a few cases of faulty operation of the relay, with the result of the severance of the transmission line because of the fact that the relays did not protect against trouble in the station. In one case, for example, there appeared to be simultaneous shorts on the transmission line and between two bushing terminals of one of the 60-kv. oil circuit breakers in the Castaic substation. With a view of studying the operation of the relays, the drawing shown in Fig. 4 was made and is now used to record the actions of the various switches when a short circuit develops.

This balance relay scheme of protection of parallel transmission lines seems to offer great promise, and when a line is equipped throughout with relays it should do a great deal toward the lessening of the expense of maintenance and of patrolling important transmission lines.

A New Portable Reflectometer

The Device May Be Used To Measure the Diffuse Reflection Factor of Walls in Place by Means of a Portable Photometer and an Integrating Photometric Sphere — Test Data Confirm Accuracy of the Method

By A. H. TAYLOR
Associate Physicist, Bureau of Standards

IN THE lighting of offices, factories, etc., the reflection of light from the walls and ceilings plays a very important part. If the illuminating engineer wants to make an intelligent forecast of the illumination which will be obtained with any lighting system which he may recommend, it is very desirable for him to know the reflection factor of the walls and ceiling. Some engineers can make good estimates of these factors merely by an inspection, but very few have had a sufficient amount of experience to enable them to do this successfully. Hence it is apparent that an instrument which would remove the element of guesswork from such factors would fill a very real need.

Previously there has not been available an instrument which would accurately measure the reflection factors of surfaces without removing them to the laboratory, but such an instrument has now been designed. It is based on the use of the integrating photometric sphere which has proved so useful in the laboratory for integrating light flux.

The theory of the reflectometer described herein was worked out by the author in 1916, and shortly thereafter the experimental instrument used in these tests was built, but pressure of other work has prevented a thorough test of it until within the last few months. The instrument consists of a small sphere, about 5 in. in diameter, arranged as shown in Fig. 1. It may be used with only diffused light on the test surface, or with a mixture of diffused and direct light. These two conditions are shown respectively in Figs. 1a and 1b. The photometer, which may be a portable photometer such as the Macbeth or small model Sharp-Millar, is attached to the small spherical reflectometer, and the observer views the opposite wall of the hollow sphere through the hole *C*. The portion of the sphere *c'* is cut off by a plane, leaving the opening *c''*. The surface to be tested is placed over this opening, and the light from a small low-voltage lamp is directed into the sphere wall or onto the test surface, depending on whether the lamp is at *A* or *B*. The attachments are so constructed that their positions are interchangeable. In the experimental instrument the area of the portion cut off was 10 per cent of the total sphere area.

MEASURING REFLECTION FACTOR OF A WALL IN SITU

THEORY OF REFLECTOMETER

The interior illumination of a hollow sphere with diffusely reflecting walls may be considered as composed of two parts—(a) the light received directly from the light source, and (b) the illumination made up of light diffusely reflected from the sphere walls. The part (b) is the same in value at all points in an empty sphere, in accordance with the

theory of the integrating sphere. Assume the hollow sphere arranged as shown in Fig. 1a. Let the area of the complete sphere be unity. When the arrangement of the sphere is that shown in Fig. 1a, the diffuse reflection factor of the test surface, Mx, may be determined from the equation

$$M_x = a(K_x - 1)[c''m + a(1 - m)] \div [ac'(1 - m) + mc''(c' + K_x a)],$$

Where c' = ratio of sphere area cut off to total sphere area,

c'' = ratio of hole to total sphere area,

$a = 1 - c'$ = fraction of total sphere area which remains,

b_o = average brightness of sphere wall, due to reflected light only, when hole is uncovered.

b_x = average brightness when hole is covered with a flat test surface having a reflection factor m_x.

b = brightness when test surface has same reflection factor as sphere surface, m.

$$K = \frac{b}{b_o} \text{ and } K_x = \frac{b_x}{b_o}$$

m_x = diffuse reflection factor of sphere surface, and

$$K_x = (a + c'm_x)[mc'' + a(1 - m)] \div [mc''(1 - m_x' + a(1 - mQ].$$

The reflection factor of the sphere surface is determined from

$$m^2[c' - a + Kac''] + ma[c' + (c'' - a)(1 - K)] + a^2(1 - K) = O, \quad (2)$$

The above equations have been derived for the case where the direct light from the lamp is incident on the sphere wall. While it is possible to use the reflectometer with that arrangement, it is much more sensitive to changes of reflection factor of the test surface, and therefore more accurate, if it is arranged so that the direct light is incident on the test surface. The most convenient method is to use the former arrangement and determine the value of m from equation (2); then arrange the instrument so that the light is incident directly on the test surface, as shown in Fig. 1b. By using for a reference standard a surface painted with the sphere paint or something less perishable, it is then possible to evaluate in absolute measure the reflection factor of any test surface. The value, m'', for any test surface may be determined as follows:

Let c', c'', a, m and m_x have the same meaning as before.

Let b' = brightness of sphere surface when the hole is covered with a test surface of factor m_x.

m' = reflection factor of the reference standard

R = (value of b° when hole is covered with surface m'') ÷ (value of b' when hole is covered with surface m').

$$= m''[a(1 - m) + c''m(1 - m)] \div m'[a(1 - m) + c''m(1 - m'')]$$

Solving for m'', $m'' = Rm'[a + m(c'' - a)] \div [a(1 - m) + c''m(1 - m' + Rm')]$ (3)

In the special case where $m' = m$, we have $m'' = m_x = Rm[a(1 - m) + mc''] \div [(1 - m)(a + c''m) + Rm^2c'']$.

In order to verify the theory of this instrument a graded series of test objects was made up. Neutral gray objects were obtained by mixing black drawing ink and lampblack with a white cement ("Keene's fine"). They were surfaced with coarse sandpaper, resulting in fairly good diffusers.

The test objects were first tested for reflection factors by the point-by-point method. The objects were illuminated normally by a 60-watt vacuum tungsten lamp, and the surface brightness was measured at intervals of 10°. The amount of flux reflected was then calculated by applying the proper factors, and since the incident flux was known, the ratio of the reflected to the incident flux gave the reflection factors of the test surfaces.

A number of the cement standards and a block of magnesium carbonate were measured by both methods

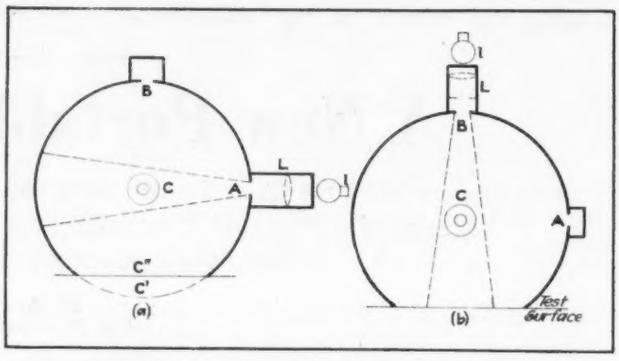


FIG. 1—TWO ARRANGEMENTS OF SPHERE REFLECTOMETER

L—Lighting tube with concentrated filament lamp *l*. B and C —Observation windows. Portable photometer may be used to observe brightness of windows. The functions of openings A, B and C are interchangeable.

of using the reflectometer and by the point-by-point method just described. By the use of equation (2), using a flat test surface painted with the same paint as that used in the reflectometer, the reflection factor of the sphere surface was found to be 88.3 per cent. This value was then substituted in the equations and the reflection factors of the various test objects were computed. The results of the measurements in the three different ways are shown in the table.

It will be noted that the agreement between columns 1 and 2 is almost perfect, and that for factors above

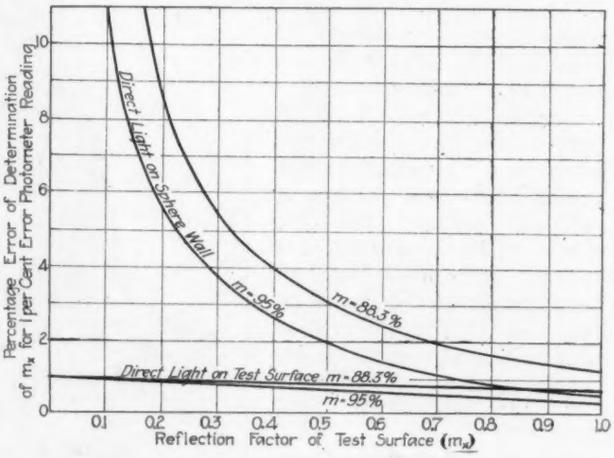


FIG. 2—CURVE SHOWING SENSITIVENESS OF METHOD FIG. 1A

80 per cent column 3 is also satisfactory. The differences between this and the other columns may be in part real, as the reflection factor for light incident diffusely may be higher than for light which is mostly incident normally. It is probable that the differences are partly experimental, as the method represented by column 3 is not very sensitive. This is clearly shown by the curves in Fig. 2. The very high value for mag-

REFLECTION FACTORS (IN PER CENT) BY THREE METHODS OF MEASUREMENT

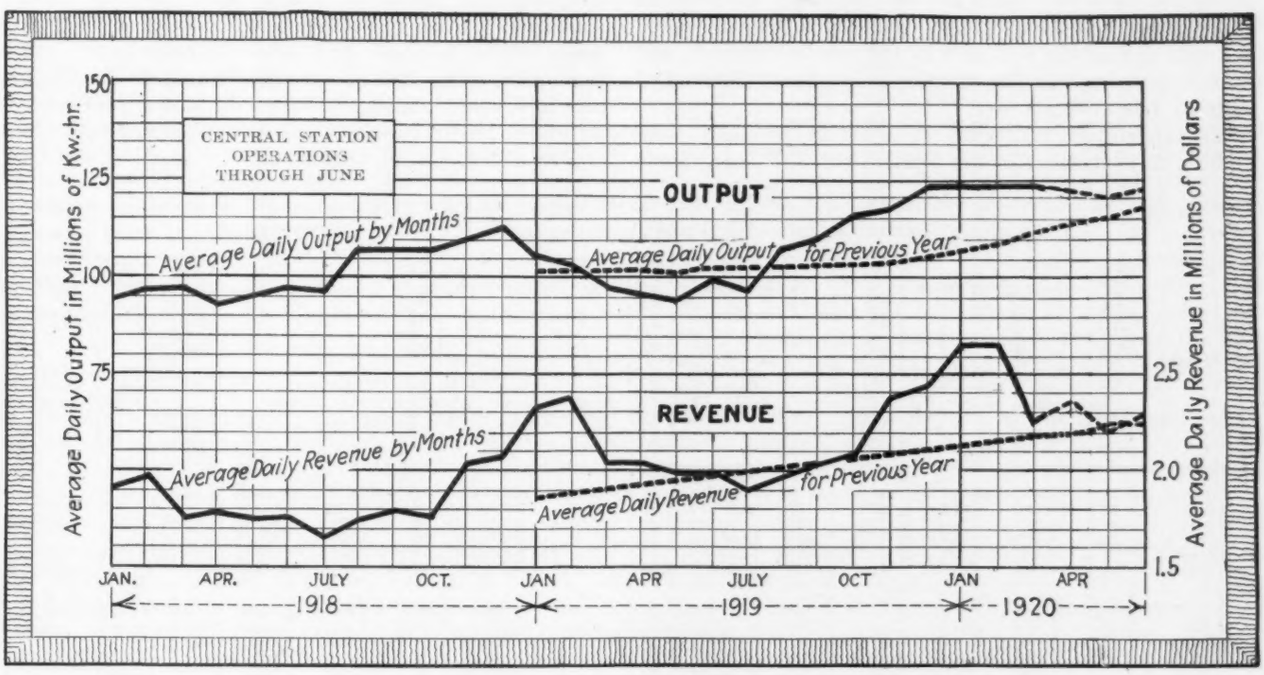
Test Object	Point-by-Point (1) Method	Sphere Reflectometer — Direct Light on (2) Test Objects	Sphere Reflectometer — Direct Light on (3) Sphere Wall
Cement Standard: No. 1	17.7	18.4	21.9
No. 2	23.7	23.9	28.2
No. 3	31.5	31.6	35.2
No. 4	36.3	37.1	39.6
No. 5	42.9	42.9	46.4
No. 6	60.0	60.7	62.8
No. 7	67.4	67.3	70.2
No. 8	81.9	81.4	82.7
No. 9	86.5	85.5	86.8
No. 10	90.8	90.4	89.6
Magnesium carbonate	99.3	99.1	98.7

nesium carbonate has been verified by still another absolute method, so that there seems to be little room for doubt that the value of 99 per cent for this particular block is substantially correct. The value previously assigned to magnesium carbonate by another investigator, 88 per cent, is seen to be very much too low.

If the reflectometer is adapted for use with a portable photometer as herein suggested, it can be used to measure the reflection factor of any flat surface *in situ*, as the instrument can be placed against the surface to be tested. If the arrangement shown in Fig. 1a is used, all readings are referred to readings taken with the hole open and light escaping, but this arrangement is not recommended for accurate work. If the arrangement shown in Fig. 1b is used, it would be best to refer all readings to those obtained when a reference standard surface such as depolished milk glass is used. Such a surface is preferable to one painted with the sphere paint when routine tests are being carried out, as it is very easily restored to a cleanly condition by through washing.

In the use of this reflectometer certain precautions should be observed in order that the results may be reliable. More complete information regarding the use of the instrument and the complete derivation of equations may be obtained from Scientific Paper No. 391 of the Bureau of Standards, which will be issued in the near future.

Slightly Improved Industrial Conditions Increase Output



THAT slightly improved transportation and labor conditions resulted in an increased demand for electrical energy for the month of June as compared with May is indicated by returns received by the ELECTRICAL WORLD. The average daily output for June was only 2,150,000 kw.-hr. less than during December, 1919, which is the record month for central-station operation. The average daily output for the first half of the year was 123,600,000 kw.-hr., and at no time during that period did the output fall below 120,000,000 kw.-hr. A range of only 5,000,000 kw.-hr. in average daily energy demand between winter and summer is a clear indication of the leveling effect on central-station operation of the rapidly increasing power load.

The modification of the transportation congestion in most of the industrial centers, especially during the first part of June, is reflected in increased demand for central-station power. Every section of the country showed increased energy consumption over May. Several strikes involving about 28 per cent of the textile workers of the New England States took place during the first

TABLE I—CENTRAL-STATION RETURNS FOR TWELVE MONTHS

	Percentage of Installed Capacities Represented	Revenue from the Sale of Energy			Percentage of Installed Capacities Represented	Kw.-Hr. Output		
		1919 Thousands	1918 Thousands	Per Cent Increase		1919 Thousands	1918 Thousands	Per Cent Increase
July	44	$25,794	$22,568	14.1	44	1,309,301	1,281,874	2.0
Aug.	54	32,756	29,006	13.0	54	1,801,836	1,793,706	0.5
Sept.	53	32,344	28,336	14.0	53	1,761,582	1,695,862	4.3
Oct.	55	35,492	30,077	18.0	60	2,175,636	1,987,004	9.0
Nov.	53	37,439	31,927	17.2	58	2,055,428	1,895,693	8.2
Dec.	59	44,125	37,978	16.0	65	2,509,571	2,270,833	10.0
		1920	1919			1920	1919	
Jan.	57	46,614	39,002	19.8	67	2,581,096	2,186,732	18.0
Feb.	63	45,881	37,502	22.1	69	2,494,764	1,986,493	25.3
Mar.	65	46,155	36,840	25.0	70	2,698,890	2,103,587	28.0
Apr*	65	45,547	36,541	24.5	70	2,603,692	2,098,559	24.1
May†	65	44,025	35,632	23.5	70	2,616,795	2,174,523	20.3
June‡	66	44,250	35,547	25.2	71	2,609,105	2,169,598	20.2

*Includes estimates for thirty-three companies, representing 6.9 per cent of the total installed capacity of all central statons.
† Includes estimates for thirty-two companies, representing 4.3 per cent of the total installed capacity of all central stations.
‡ Includes esti ates for eighty-two companies, representing 18.8 per cent of the total installed capacity of all central stations.

part of June, but in some centers of this section shipping facilities improved considerably, resulting in general increased industrial activity and a consumption of power in excess of the May demand.

The steel industry continued to operate on a schedule that was much below capacity. During the first part of June transportation conditions improved considerably and increased operations were the general rule in practically all lines of industry in the Atlantic States, but the new outlaw strike of railroad workers in the latter part of the month caused more congestion in the large industrial centers of this section than was experienced in the tie-ups of early spring. The temporary increased activity during the first part of the month, however, was sufficient to increase the average daily energy demand of May by 1,180,000 kw.-hr.

Transportation continued to interfere seriously with industrial operations in the North Central States. Some automobile manufacturers estimate a production of not more than 35 per cent of that planned for this year, owing to lack of raw materials and inability to ship finished products, as well as insufficient fuel supply. Large strikes were also under way in the southern portion of this section, but despite these adverse conditions the average daily output of the central station exceeded that of May by 580,000 kw.-hr.

The public utilities in the South Central States suffered for lack of sufficient fuel, and in some instances temporary shutdowns were necessary.

The shipyard strike on the Pacific Coast was practically broken by the action of the United States Shipping Board against increasing wages. The strikes in the mining region were also settled, and mining on an extensive scale was resumed during June. This general resumption of industrial activity in the Mountain and Pacific States during June is reflected in an average daily increase of 1,020,000 kw.-hr. in central-station operations over those of May. During the first half of the year the average daily output of the central stations of this section has increased from 23,160,000 kw.-hr., recorded in January, to 24,570,000 kw.-hr. in June.

AGITATORS *who are trying to create trouble between employees and their employers as a rule are insincere and selfish. Generally they themselves have performed no hard labor nor had experience which qualifies them to lead or instruct. They strive for personal popularity and gain. Their business is better, their compensation increased, when others are in trouble. Assuming to be sympathetic and superior in intelligence, they mislead and often misrepresent. They promise reforms, but their methods lead to trouble and loss to others. In this list are included a few writers, lecturers, public speakers and self-appointed labor leaders, so called.*—E. H. GARY.

TABLE II—CENTRAL-STATION RETURNS BY SECTIONS OVER A TWELVE-MONTH PERIOD

	Month	New England States				Atlantic States				North Central States				South Central States				Pacific and Mountain States		
		Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase	Percentage of Installed Capacities Represented	1919 Thousands	1918 Thousands	Per Cent Increase
REVENUE	July	70	$3,406	$2,995	13.7	40	$9,320	$8,375	12.0	39	$7,240	$6,121	18.1	38	$1,614	$1,321	21.9	49	$4,214	$3,756	12.1
	Aug.	74	4,225	3,693	14.4	57	12,174	10,995	11.1	47	9,295	7,924	15.8	39	1,647	1,385	18.4	61	5,415	5,009	8.5
	Sept.	73	4,019	3,536	13.6	53	11,429	10,069	13.5	46	9,671	8,278	16.6	38	1,724	1,488	16.0	63	5,501	4,965	10.9
	Oct.	72	4,127	3,453	19.1	53	12,684	10,822	16.9	52	11,401	9,484	20.2	38	1,840	1,519	21.1	62	5,440	4,799	13.9
	Nov.	71	4,432	3,800	16.2	56	14,738	12,761	15.7	44	10,541	8,689	21.2	39	2,063	1,694	21.8	63	5,665	4,983	13.9
	Dec.	73	4,908	4,254	15.1	57	15,926	13,806	15.8	49	11,660	9,833	18.3	44	2,496	2,070	20.0	77	9,135	8,015	14.2
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	78	5,635	4,718	19.8	59	17,659	14,625	20.9	51	12,885	10,799	19.6	53	3,047	2,538	19.9	75	7,388	6,322	16.1
	Feb.	82	5,354	4,368	22.1	61	17,245	14,343	20.4	55	13,191	10,403	26.0	53	2,949	2,360	24.7	79	7,142	6,028	18.3
	Mar.	82	5,136	4,044	27.0	63	17,696	14,299	23.7	57	13,270	10,469	26.5	54	2,910	2,287	27.8	79	7,143	5,741	24.2
	April	82	5,087	3,943	29.0	64	17,700	14,383	23.5	57	12,690	10,042	26.9	54	2,952	2,181	35.2	79	7,118	5,992	19.2
	May	82	4,895	3,750	30.1	64	16,761	13,749	21.9	57	12,478	9,860	26.8	54	2,829	2,140	32.0	79	7,062	6,133	15.1
	June	82	4,904	3,774	30.0	65	16,451	13,521	22.0	57	12,415	9,746	27.4	54	2,801	2,132	31.5	79	7,679	6,374	20.1
KW.-HR. OUTPUT			1919	1918			1919	1918			1919	1918			1919	1918			1919	1918	
	July	70	141,551	130,393	8.2	40	373,105	378,053	−1.5	39	371,425	355,664	4.5	38	56,945	52,501	8.1	49	366,275	365,263	0.1
	Aug.	74	161,431	153,266	5.1	57	640,616	662,120	−3.2	47	496,745	460,360	8.0	39	58,991	53,231	10.2	61	444,026	464,729	−4.2
	Sept.	73	153,837	146,209	4.5	53	610,254	610,179	0.1	46	515,519	463,929	11.5	38	58,316	54,838	6.3	63	423,656	420,707	0.5
	Oct.	72	162,859	142,326	14.4	53	694,584	659,859	5.3	67	815,284	709,665	15.3	38	67,155	56,742	18.5	62	435,754	418,412	4.1
	Nov.	71	153,171	140,240	9.2	56	724,667	707,347	2 4	60	686,486	597,855	14.9	39	68,352	59,507	14.7	63	422,812	390,744	8.2
	Dec.	73	180,493	152,304	18.0	58	803,165	733,222	8.9	67	825,313	713,959	15.8	44	88,658	73,728	20.1	77	611,942	597,620	2.5
			1920	1919			1920	1919			1920	1919			1920	1919			1920	1919	
	Jan.	78	207,158	159,773	29.8	60	853,057	717,303	19.2	69	841,841	731,758	15.2	56	140,736	117,677	19.9	75	538,304	460,221	16.2
	Feb.	82	187,264	148,103	26.2	62	809,865	672,836	20.1	73	858,939	663,523	29.4	56	130,473	98,098	33.0	79	508,223	403,933	26.1
	Mar.	82	198,603	148,512	33.7	64	897,327	711,828	26.0	74	913,659	711,761	28.1	56	137,306	102,545	33.6	79	551,995	428,941	28.6
	April	82	187,174	144,922	29.1	65	883,264	701,778	25.9	74	857,467	687,751	24.7	56	135,140	99,877	35.2	79	540,647	464,231	16.7
	May	82	188,317	148,053	27.5	65	852,500	709,256	20.5	74	861,300	699,900	23.5	56	137,779	98,815	39.2	79	576,899	510,502	12.7
	June	82	187,114	149,421	25.3	66	859,654	721,762	19.1	74	847,654	682,400	24.0	56	133,380	99,447	33.9	79	581,312	516,568	12.7

Financing Electric Public Utilities—I

Tremendous General Demand for Capital Reflected by Rise in Bond Yields—This Reacts Against Regulated Business Because Public Utilities Cannot Quickly Change Prices to Follow Upward Tendency

By Dr. W. F. GEPHART*
Vice-president of the First National Bank in St. Louis

ONE of the most interesting facts in economic history is that prices pass through periods extending over several years in which the level is upward or downward. While ordinarily observations disclose great irregularity in the price of a particular commodity over short periods of time, yet careful investigation shows that prices in general are subject to this upward and downward trend. There is no agreement as to any one cause producing these cycles of prices. The significant fact is that ever since there has been money certain forces operate to produce this change in the price levels. We are now in the midst of one of these remarkable cycles.

Beginning with 1897, the price level has been upward, and the forces producing this effect have been accelerated by the world war. Commodity prices in 1860, taken as 100, had increased to 130 by 1915, and by the close of the war they had reached 230. This was the case in the United States, and a similar result is shown in all other nations. These price changes are disclosed by the various index numbers, which are the only scientific method of measuring changes in prices. These index numbers show what is happening to prices in general.

Particular prices may increase or decrease over short periods of time. Some prices may not advance so rapidly as other prices, for the forces determining a single price may in some respects be peculiar to it. For example, when monopoly exists—that is, when there is control over the supply—a larger degree of control over the price is possible. Likewise, when there is governmental control the change in price is likely not to follow so closely the general upward tendency. This is especially true if the Government regulation is of an essential and one for which the public is accustomed to paying a certain price.

Rates Must Advance with Price

Custom is an enormously strong force in controlling prices, and governmental regulation only adds another force to restrain any change in price. This combined condition of customary price and governmental regulation is found in the case of public utilities. People become accustomed to paying a certain price for their gas, their light or their telephone and are not ready to admit, in a period of rising prices, that the rate—which is but one kind of price—should advance along with other prices.

Cost elements which go to make up all prices change quite as much in the case of a public utility as in the case of a cotton mill. The manufacturers of public service must increase wages like any other manufacturer. Parts of their machine or plant must be continually replaced and the new parts must be purchased on the higher price level. The public expects additional facilities and extensions to be ready whenever it wishes them, and these too must be bought at the increased price level.

In short, a public utility is no more free than any other producer of a commodity or service to resist the force of increased prices. Indeed, such companies are not so free as is a private manufacturer. Government regulation is established to see that the public gets good service at a fair price. The private producer can reduce his labor force or even temporarily close his factory as a measure of economy, but not so with the public utility. All the time the public must be served and its good will secured, and at a price fixed not by the producer but by the state.

A public utility company can never take advantage of the market as the private producer does and build up large profits and surpluses for the inevitable periods of no profits. The assumption of Government regulation is that the owner of public utilities will secure a fair return at all times, but in actual practice it is difficult to secure this for him.

No Sentiment in Capital

Whatever may have been the injustice of the conduct of such companies in the past, such injustices cannot now be corrected. It is water which has run under the bridge. The important fact is that private capital is invested in public utility properties just as in private corporations. This capital is subject to business risks as in a private enterprise. It is taxed. Its return is controlled by the state by largely inflexible rates. In short, the same considerations which determine the flow or investment of capital in any business govern the investment of capital in this field.

What is the situation then of many of our public utilities under prevailing conditions of an increasing price level, a regulated rate of return, or price, an unsympathetic public, a selfish capital, seeking as always the best possible investment, with an increasing number of bidders for the use of capital and a decreasing amount of capital for sale?

In the first place, there is a tendency toward a deterioration of the physical plant and force. Private industry producing its product for a sellers' market—that is, at high prices—is able both to pay more for materials and to pay higher wages to employees.

In the second place, extensions cannot be made with accustomed and desirable regularity owing to the high prices and dearth of material and labor, the reduced earnings and the lack of new capital. Public utility corporations operate very largely under the law of increasing returns; that is, the net return on increased units of service is greater than the proportional outlay required to furnish this increased service.

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In the third place, the most significant of all the effects is the refusal of new capital to flow into this field. A period of rising prices brings many opportunities to capital to receive a higher rate of interest, for it must never be forgotten that the rate of a return is a price—the price of capital—and, like all other prices, should and must advance if capital is to be forthcoming. There is a cost of money just as there is a cost of wheat or pig iron.

Experience shows that rising commodity prices are accompanied by a rise in bond yields. Superficially the cause for this would seem to lie in the fact that with rising prices, the investor finding his real income reduced, would demand a larger return for the use of his capital and hence bond yields would tend to rise. Another factor entering into the situation lies in the fact that with a rise in commodity prices the demand for capital must necessarily increase, as the higher prices require a larger volume of capital in the conduct of business. Likewise, during a period of falling commodity prices the situation is reversed, so that bond yields tend to follow commodity prices downward. As prices decrease the volume of capital required in industry is lessened and the demand for capital thus falls off, lowering its price.

The yield on bond prices follows the curve of commodity prices rather closely. From an average yield of between 7¼ and 8¼ per cent in 1873 they dropped to an average yield of from 4¼ to 4½ per cent in 1890, rising somewhat between 1890 and 1895. After 1895 they declined to their lowest point for the period in the year 1900, showing at that time an average yield of about 3¾ per cent. After 1900 they gradually rose and by the beginning of the world war the average yield on corporation bonds was between 4¾ and 5 per cent. By the close of the war the yield had risen to between 5¼ and 5¾ per cent. Since the close of the war the average yield has risen even more rapidly, and at present it averages about 7.05 per cent.

COST OF MONEY TO PUBLIC UTILITY CORPORATIONS

In endeavoring to determine the cost of money at the present time to public utility corporations there are several important factors that must be taken into consideration. The cost of money incident to the acquisition of the first money needed by a new corporation would be different from the cost to obtain money for enlargements or improvements in a going concern. This is due to the fact that only a part of the total capital needs of a corporation can be secured by a first lien on the property. In other words, all of the securities issued by a corporation cannot be equally secured as regards assets.

Usually not above 60 per cent of the total bonded indebtedness of any corporation can be secured by assets termed the highest class. The remaining 40 per cent of the company's capital needs must thus be raised through the sale of junior issues. No corporation can hope to raise its entire capital needs by a single issue secured by a first mortgage on its entire property value. Since a large part of capital needs must be raised through junior issues, they can be sold only if the yield is considerably higher than that offered by a senior issue.

In the case of a going concern seeking additional capital it is practically impossible to offer the new securities in any volume on a parity with the senior issues of the company, even though the company is thoroughly sound and conservatively managed. Even aside from the nature of the security, new issues are always at a disadvantage in relation to the more seasoned issues which have been fairly digested by the investing public. The result is that new securities offered for the purpose of additions and betterments must usually not only compete with the yield afforded by the junior issues of the company, but, in order to attract new capital, must offer even a higher yield.

UTILITY CREDIT WANING

The credit of public utility corporations, on the whole, is at present more or less in disrepute so far as the general investor is concerned. This is not a matter of theory or opinion but one of fact. A glance at the price at which the highest grade of public utility securities in the United States are selling at the present time proves this beyond a doubt. The highest grade of American public utility securities can be purchased in the open market on a basis that will yield the investor anywhere from 1 to 2 per cent per annum more than the same sum would yield were it invested in any other similar grade of corporation securities.

TABLE I—BOND YIELDS BEFORE THE WAR AND SINCE

	Now	Month Ago	Jan., 1916	July, 1915	Before War
U. S. average five public utility	8.60	8.19	5.18	5.31	5.09
U. S. average five railroad	6.14	5.86	4.51	4.71	4.42
U. S. average five manufacturing	6.41	5.92	4.89	4.99	4.93

According to the bond yield computed on five average United States public utility bonds by "Brookmire's Economic Service," this type of security on May 1 could have been bought on a basis to yield more than 2 per cent in excess of the yield afforded by a similar investment in other railroad bonds or manufacturing companies. According to Brookmire's figures, the average yield on five public utility bonds considered as representative issues was 8.60 per cent on this date. On the same date the yield on five representative railroad bonds was 6.14 per cent. Table I, taken from Brookmire's *Financial Bulletin* of May 3, shows the changes in bond yields since before the war.

In another section of this article to appear in an early issue an analysis of the average yield of public utility bonds and the cost of money to public utility and other corporations will be presented.

THE *technical engineer is coming to the fore in power-plant work, this being chiefly on account of the greater need for engineering knowledge and the ability to analyze conditions, so as to get the best results out of every heat unit in the fuel field. I am also inclined to think that the present type of fireman will be obsolete in a few years, the so-called fireman being replaced by boiler-room engineers or combustion engineers. The engineer of the future will not be the throttling type, the opening and closing of the throttles being done by his assistants. His work will be to study plant conditions, work up data and analyze the general working conditions of his plant and make every heat unit count. The combustion engineer will study fuels, furnace designs, etc., so he can burn coal with minimum loss and at the same time give up greatest amount of heat to making steam.*—HENRY H. CARTER *in Southern Engineer.*

Auto-Transformers for Motor Starting

Heating, Ruggedness and Economical Production Are Principal Considerations in Design of Auto-Transformers for Synchronous and Induction Motor Starting—Effect of Voltage Tap and Speed of Motor Influence the Cost of Starter

By THEO. SCHOU
Chief Engineer the Ideal Electric & Manufacturing Company

ALTHOUGH the one-coil transformer, commonly called the auto-transformer, is superior to a two-winding, or normal, transformer as far as economy and performance are concerned, its application and use as a power transformer are limited to cases where the voltage ratio is low, owing to the fact that in an auto-transformer the primary and secondary circuits are not electrically separated. As part of the starting equipment, however, for squirrel-cage induction motors and self-starting synchronous motors, its application is general, and as such the design of auto-transformers is more or less special.

So far as the writer is aware the available information on this subject is meager, and therefore its discussion seems both timely and desirable. In what follows the discussion refers only to auto-transformers for starting duty in connection with motors of both the induction and synchronous type. Besides giving a brief theory it will contain information as to design and construction. It should be borne in mind that less consideration is given to regulation and efficiency than in the design of ordinary transformers and more to the heating, mechanical stability and economy of production.

Current and Voltage Relations Derived.—Fig. 1 shows diagrammatically a three-coil auto-transformer for three-phase operation where:

E_1 = line voltage, or voltage between incoming lines.
E_2 = reduced voltage applied to motor terminals at starting.
W_1 = total effective turns per leg, or primary turns.
W_2 = secondary effective turns per leg (being part of the primary and determined by voltage tap used).
I_1 = line current.
I_2 = current in motor circuit.

We have:

$$(E_1/E_2) = (W_1/W_2), \text{ or } E_2 = E_1(W_2/W_1)$$

and:

$$(I_1/I_2) = (W_2/W_1), \text{ or } I_2 = I_1(W_2/W_2)$$

The current circulating in the part of the winding designated $(W_1 - W_2)$ is I_1, but in the part designated (W_2) it is $I_2 - I_1$; therefore, winding W_2 may have smaller cross-section of effective conductor than the winding $(W_1 - W_2)$, and the proportion of copper weight to that of a normal two-coil transformer of the same duty would be $(E_1 - E_2)/E_1$.

The larger E_2 is, therefore, the more economical in saving in copper.

Determination of Design Constant.—If

E = phase voltage,
I = current per phase,
q_{fe} = iron core section in sq.cm.,
q_{cu} = Copper section (of effective conductor) in sq.mm.
L_{fe} = mean length of magnetic path in cm.,
L_{cu} = mean turn of winding in cm.,
B = magnetic density (Maxwells),
A = current density per sq.mm.,
g_{fe} = weight per cubic unit of iron,
g_{cu} = weight per cubic unit of copper,
W = number of turns in series,
f = frequency in cycles,

then for single-phase transformers we have:

$$\text{Kva.} = EI10^{-3}.$$

Now:
$$E = 4.44fW\phi 10^{-8}.$$
$$= 4.44fWBq_{fe}10^{-8},$$

and, as $I = Aq_{cu}$,
then: $\text{Kva.} = 4.44fWBq_{fe}Aq_{cu}10^{-11}$,
or, if B and A remain constant:
$$= K_1fWq_{fe}q_{cu}10^{-11},$$
where: $K_1 = 4.44BA$.

Total iron weight (G_{fe}):

$$G_{fe} = q_{fe}L_{fe}g_{fe}10^{-3}Kg. \text{ (if in c.g.s. units)}$$

Total copper weight (G_{cu}):

$$G_{cu} = q_{cu}L_{cu}g_{cu}2W10^{-3} \text{ (if primary copper = secondary copper)}$$

$$\frac{G_{fe}}{G_{cu}} = \frac{q_{fe}L_{fe}g_{fe}10^{-3}}{q_{cu}L_{cu}g_{cu}2W10^{-5}} = K_2\frac{q_{fe}}{q_{cu}W}10^2,$$

when L_{fe}/L_{cu} remains constant throughout a certain line. We obtain from this:

$$Wq_{cu} = K_2(G_{cu}/G_{fe})q_{fe}10^2,$$

and, by substituting:

$$\text{Kva.} = 4.44BAK_2f(G_{cu}/G_{fe})q_{fe}^2 10^{-9}$$
$$= Kf(G_{cu}/G_{fe})q_{fe}^2BA10^{-9}.$$

Or:

$$q_{fe} = K\sqrt{\frac{Kva.(G_{fe}/G_{cu})10^9}{fBA}} = K\sqrt{\frac{Kva.(\gamma 10^9)}{fBA}}$$

Where $\gamma = G_{fe}/G_{cu}$.

If we calculate in inches and Kapplines, we have, as:

1 Kapp-line = 6,000 c.g.s. lines,
1 square inch = 646 eq.mm².,

$$q_{fe} = C\sqrt{\frac{Kva.(\gamma 10^6)}{fBA}},$$

or design constant:

$$C = q_{fe}\sqrt{\frac{fBA}{Kva.(\gamma 10^6)}}.$$

This equation holds good for all types of transformers.

Performance Duty Consideration in Starter Design.—Auto-transformers used in connection with motor-starting equipment are in service, or in circuit, for a short time period only—a minute or two—in the average application even less than that. Therefore the design constant of such transformers naturally differs from the usual normal transformers. Heating and stability,

both electrical and mechanical, together with economical production, are the main features to be given consideration. Efficiency and regulation naturally do not take the part they do in the case of ordinary continuous duty transformers.

Magnetic and Current Characteristics.—Both magnetic and current densities are of much higher value than in the case of normal transformer designs; therefore the proportion of net iron weight to net copper weight, or the constant γ, is also different from usual practice. These values vary, depending upon type, voltage, size and frequency, and will later be discussed more closely in connection with a certain type of auto-transformer construction.

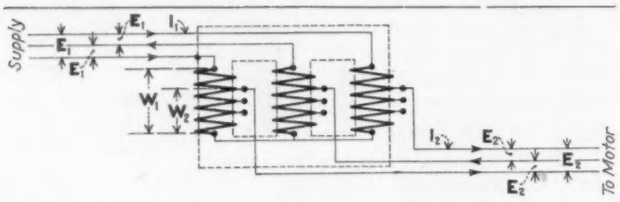


FIG. 1—CONNECTION OF AUTO-TRANSFORMER FOR MOTOR STARTING

Types.—Auto-transformers may be oil-cooled or air-cooled. They are built as core-type or shell-type. Considering its application and performance duty, the air-cooled core type seems to be the most popular recent design for ordinary line voltages.

Rating.—The kva. or horsepower rating of the auto-transformer is identical with the kva. or horsepower rating of the motor with which it is used. The design, however, of an auto-transformer is based on the starting characteristics of the motor as far as kva. inrush is concerned. It is, therefore, of importance that such starting characteristics of the motor shall be known before the design of the auto-transformer is attempted.

Kva. and Current Drawn from Line at Starting.—The kva. inrush to an induction or synchronous motor at standstill depends upon the applied voltage and the impedance of the motor. If:

E = applied voltage on motor (terminal-terminal),
I = current drawn from line,
Z = total motor impedance per phase, in ohms,

then:

$$I = E/\sqrt{3}Z \text{ for three-phase;}$$

$$I = E/Z \text{ for two-phase.}$$

Now:

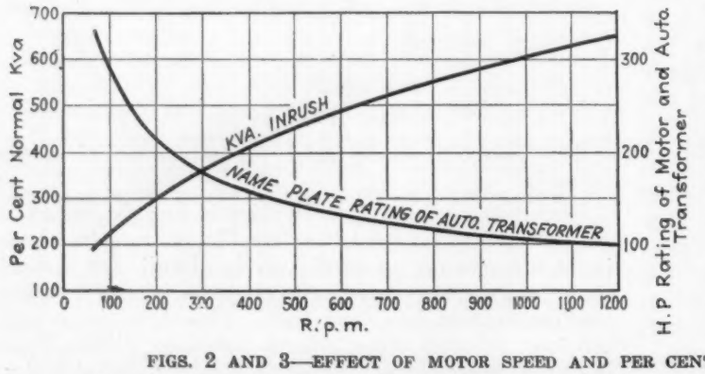
$$Z = \sqrt{(\Sigma R)^2 + (\Sigma x)^2}$$

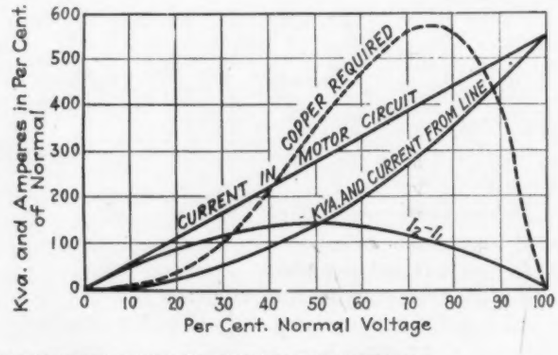
Where:

ΣR = total resistance per phase in ohms; *i.e.*, primary resistance per phase + secondary resistance per phase reduced on primary.
Σx = total reactance per phase in ohms; *i.e.*, primary reactance per phase + secondary reactance per phase reduced on primary.

For a symmetrical line of motors it will be found that the total reactance and also the total resistance (thus the impedance) will increase as the speed decreases. Therefore the current drawn from line, expressed in percentage of normal motor current, will at a certain applied voltage increase as the speed increases. Fig. 2 shows how the kva. inrush at normal or 100 per cent voltage will vary with the speed for a certain line of self-starting synchronous motors, and in connection with this a most interesting fact, *i.e.*, the possible change of name-plate rating of one and the same auto-transformer when applied to different speed motors. Referring to Fig. 2, the same auto-transformer applies both to a 100-hp., 1,200-r.p.m., and a 250-hp., 150-r.p.m. motor. The kva. inrush curve also indicates that for very low-speed synchronous motors the auto-transformer and its auxiliaries may be eliminated; or, in other words, the low-speed motor may be thrown directly on the line, provided that the field design of the synchronous motor will stand full applied voltage at the armature terminals. The starting kva. and also the line amperes vary directly as the square of the applied voltage, and taps are brought out from the auto-transformer winding so as to limit the line current to a commercial value. It should also be kept in mind that as the starting torque of the motor also varies with the square of the applied voltage such taps must be selected and used for a motor circuit as will meet both conditions; that is, taps which will limit the kva. inrush from line to a certain value and at the same time enable the motor to start its load. Fig. 3 gives the kva. inrush, current from line (I_1), current to motor circuit (I_2), and also current in the "W_2" part of winding "$I_2 - I_1$" (see Fig. 1) expressed in percentage of normal motor kva., or amperes. Fig. 3 also indicates, by the dotted curved line, how the copper weight changes with the voltage tap on which the design is based. Although only one tap is used the auto-transformer coil is usually provided with, say, three taps to meet different starting conditions, and the design must therefore be based on the worst condition.

It is to be noted (see Fig. 3) that approximately the 75 per cent voltage tap calls for the maximum copper, other things being equal and the magnetizing kva. neglected.





FIGS. 2 AND 3—EFFECT OF MOTOR SPEED AND PER CENT VOLTAGE ON AUTO-TRANSFORMER DESIGN

Note that the same auto-transformer will serve a motor three times as large at 100 r.p.m. as at 1,200 r.p.m. (Fig. 2). Copper required is maximum when starter is designed for 75 per cent voltage.

Owing to its simplicity of design, production, mounting and connections the two-coil, three-core, air-cooled type of auto-transformer seems to adapt itself most satisfactorily as a starting transformer where, as mentioned above, finer points as to performance and design are not of great importance. In order to have the same core for two-phase and three-phase operation the middle core is given approximately 40 per cent larger cross-section than the two outer ones. For a given voltage the coils are also the same for both two-phase and three-phase transformers of the same rating—being connected in open delta for three-phase and in the ordinary way for two-phase.

The only serious drawback in connection with this type of construction is that it can hardly be used in connection with three-phase, four-wire equipment. In this case, triple frequency current is free to circulate, and the flow of such current in the neutral wire is three times that of the line. If, however, the motor armature insulation will warrant it, and in most cases it will, this drawback can be eliminated by not grounding the motor.

Specific Values of Design Constants.—For auto-transformers of this type and construction, designed for 60-cycle operation and normal line voltages, the design constant C may vary from 1.5 to 2, and the constant γ from 3 to 5. The magnetic density may vary from 15 to 18 Kapp-lines, and the current density from 13,000 to 19,000 amp. per square inch. It is also of interest to note that in applying the above values the proportion for total net weight of effective material over horsepower rating—*i.e.*, $(G_{fe} + G_{cu})/$ hp.—varies from 0.80 for large to 2.25 for small transformers.

Auto-transformers made by a manufacturing concern which also builds other dynamo-electrical apparatus may conveniently be built as a by-product, using much of the scrap iron and copper left available from the manufacturing processes of other machines.

The cores may be built with lapp or butt joints. However, butt joints will be found to be the more economical and are about as good magnetically as lapp joints.

When butt joints are used care should be taken, however, that means be provided for holding the parts securely in place. The coils are subjected to rather heavy mechanical stresses when the current is thrown on, and it is important so to design the coil that the various layers of the winding cannot in any way change in relative position or telescope into each other. The coil proper, also, should be prevented from any movement on the core and should be rigidly supported and held in permanent position; otherwise breakdowns may easily occur.

THE *experience of generations shows that successful industry tends irresistibly toward the development of very large units. Such units are necessary to efficiency. The tendency is wholesome, and cannot be successfully resisted. Anti-trust legislation, trust-busting campaigns and government suits to dissolve the great industrial units cannot frustrate the fundamental economic law. Large units will emerge in spite of them, because they are economically necessary and sound. . . . While monopoly produced by unfair methods may be perpetuated as long as such methods are used, the monopoly produced by efficient management cannot be perpetuated, because efficiency cannot be monopolized.* —PHILIP CABOT.

Proposed Reorganization of the Electric Systems of Belgium

IN AN article which appeared in the *Revue Universelle des Mines, de la Métallurgie et des Travaux Publics* last year and was summarized in the *Revue Générale de l'Electricité* for March 27 last Fernand Courtoy gave the outlines of a plan of which he is the author for the interconnection of all the electric supply lines of Belgium with the object of conserving fuel and promoting economy in the production of energy. There is little water power in Belgium, and coal is the chief source of electricity, though gas from blast furnaces and from coke ovens is used in some districts.

Pointing to the great importance of a well distributed load such as could be brought about by the operation in parallel of a group of power stations, with the attendant regulation of demand, diminution of total necessary generating capacity and possibility of employing units of greater power than can be done under independent operation, the author favors the establishment of a number of great central stations in favorable localities, the transformation of the existing smaller generating plants into distributing stations, and their interconnection by a network of cables.

The statistics of 1911, which are the latest available, showed a total installation in the central stations of Belgium of approximately 563,000 kw., of which about 164,000 kw. was reserve power. The total annual production of electricity was 1,570,230,000 kw.-hr., with a load factor of 45 per cent. Assuming the same amount of business, a common supply of energy to all industries would, according to the author's figures, limit to 322,000 kw. the maximum power demand, which is now 399,000 kw.; the annual load factor would rise to 61 per cent; reserve capacity could be reduced to 25 per cent of output, and finally the total rating of generators installed could be reduced from 563,000 kw. to 382,000 kw. This method of operation in common could be realized either by operating in parallel installations indentical with those of 1911 or by means of two groups of great central stations—one group utilizing steam units of 20,000 kw. and the other group, built in localities where blast furnaces exist, utilizing gas engines rated at from 4,000 kw. to 8,000 kw.

The connections between central stations of the same group would be furnished by armored cable carrying three-phase current at 6,000 volts and 50 cycles. Interconnection of the groups would be provided by aërial conductors at 100,000 volts. The substations tying together the 100,000-volt and 6,000-volt networks would be equipped with automatic apparatus utilizing static transformers.

A comparison from the viewpoint of economy of four successive evolutionary plans of parallel operation shows yearly savings in coal, as contrasted with independent operation as in 1911, of from 1,769,315 tons to 2,257,800 tons; savings in yearly operating costs of from 74,583,855 francs to 135,959,925 francs, and savings in the net cost of producing a kilowatt-hour of from 2.75 centimes to 6.65 centimes. The lowest figures in each case are for the ultimate scheme—that involving the abadonment of all existing installations.

No legislative sanction has yet been obtained for the plan. As to financial organization, the author advocates a combination of all the supply companies, big and little, that existed before the war.

U. S. Census of Central Stations 1917

Analysis of Census for 1917, Just Issued, Indicates 6,542 Central Stations, with Installed Rating of 8,994,407 Kw. and Total Output of 31,044,049,234 Kw.-Hr.—Stationary Motors Served Number 555,924, with Continued Rating of 9,216,330 Hp.

THE 1917 census of electric light and power stations, which has just been published by the Bureau of the Census, Department of Commerce, is by far the most comprehensive census of the central-station industry yet issued by that bureau and contains a number of important changes in and additions to previous reports. Among these is a clear distinction between generators operated by water power and those operated by other power, a detailed classification of the current sold for electric lighting, power, to other public service corporations, energy used by the plant itself, distribution and line losses, in addition to the amount generated and purchased; separate data regarding income from the light and power business, data on fuel consumption and population of areas served with electric current.

Table I, a combination of Tables VIII and IX of this report, gives a comparative summary of the operation of the commercial and municipal plants for 1907, 1912 and 1917. It is interesting to note that while the commercial plants represented only 64.6 per cent of the total number, yet they served 82.7 per cent of all municipalities furnished with current and 80.5 per cent of the aggregate population of all districts served with electric current. In its analysis the Bureau of the Census states that "this is due to the fact that most commercial stations distribute current directly to consumers throughout an extensive territory, some supplying scores of separate localities, while almost without exception municipal plants serve only the municipalities in which they are located. On the other hand, frequently several commercial plants are located in the same city, one usually doing a general light and power business, while the others may incidentally do a little lighting, but will in the main supply power to other companies. There were 405 cases of this kind in 1917." While no effort was made in this census to secure data on the number of isolated or private plants, yet computations based on this census indicate that in 1914 there were 45,000 electric plants operated solely in connection with industrial enterprises. The output of all generating stations in 1917 was 25,438,303,272 kw.-hr. and the amount purchased was 5,605,745,962 kw.-hr., making a total central-station output of 31,044,049,234 kw.-hr.

The number of stations increased more rapidly (25.3 per cent) from 1912 to 1917 than during the previous five-year period, when the rate of increase was only 10.8 per cent. For both periods the numerical increase was considerably more rapid for municipal plants. Those items which show the greatest increase since the 1907 census are: Value of plant and equipment, 179 per cent; total income, 200 per cent; expense, 217.9 per cent; total horsepower of prime movers, 215.7 per cent; kilowatt capacity of dynamos, 232 per cent; kilowatt-hours generated, 333.9 per cent; number of customers, 268.7 per cent, and horsepower of stationary motors served, 458.9 per cent. There was a falling off in the rate of increase in investments for the five-year period from 98.3 per cent to only 40.7 per cent, though there was not so much difference in the absolute increase. The bureau attributes this to a more widely established business and the abnormally high cost of materials subsequent to 1914.

In 1917 there were eight states in which the number of municipal stations exceeded the number of commercial stations, this excess being most marked in Georgia, where it was 80, and in Kansas, with an excess of 70. The large increase in municipal plants indicated in Table I is not so remarkable when the fact is considered that these were mostly small plants serving but one locality, while one commercial plant may mean a territory served embracing many separate municipalities. It is also noticeable that the districts showing the largest growth in municipal plants are those in which oil, natural gas or

TABLE I—COMPARATIVE SUMMARY OF COMMERCIAL AND MUNICIPAL CENTRAL STATION OPERATIONS

	Commercial Plants			Municipal Plants			Total
	1907	1912	1917	1907	1912	1917	1917
Capitalization	.....	.....	$3,117,809,898	.....	.....	$127,375,200	$3,245,185,098
Number of stations	3,462	3,659	4,224	1,252	1,562	2,318	6,542
Value of plant and equipment	$1,054,034,175	$2,098,613,122	$2,933,016,941	$42,879,447	$77,065,144	$127,375,200	$3,060,392,141
Total income	$161,630,339	$279,054,409	$486,634,021	$14,011,999	$23,218,989	$40,260,219	$526,894,240
Light, heat and power	$156,000,257	$264,474,949	$462,473,917	$13,614,434	$22,663,708	$39,586,063	$502,059,980
All other sources	$5,630,082	$14,579,460	$24,160,104	$397,565	$555,281	$674,156	$24,834,260
Total expenses, including salaries	$123,880,291	$217,660,112	$395,127,395	$10,316,620	$16,917,165	$31,440,912	$426,568,307
Total number of persons employed	42,066	71,395	94,679	5,566	7,940	10,862	105,541
Prime movers:							
Number	8,981	9,326	10,387	2,017	2,576	3,408	13,795
Total horsepower	3,776,837	6,970,716	12,077,657	321,351	559,328	859,098	12,936,755
Dynamos							
Number	9,778	9,843	9,991	2,395	2,767	3,437	13,428
Kilowatt capacity	2,500,209	4,768,762	8,411,944	209,016	396,677	582,463	8,994,407
Output of stations: (total)	5,572,813,949	13,556,505,383	29,812,190,746	289,462,788	626,107,107	1,231,858,488	31,044,049,234
Kilowatt-hours generated	5,572,813,949	11,031,583,155	24,398,983,183	289,462,788	537,526,730	1,039,320,089	24,438,303,272
Kilowatt-hours purchased	.....	2,524,922,228	5,413,207,563	.....	88,580,377	192,538,399	5,605,745,962
Stationary motors served:							
Number	162,677	413,578	504,804	4,507	21,895	51,060	555,924
Horsepower capacity	1,617,337	3,966,328	8,790,707	31,689	164,291	425,623	9,216,330
Disposal of current, 1917:							
For light	.....	.....	4,445,217,785	.....	.....	667,299,164	5,112,516,949
For power	.....	.....	12,833,191,106	.....	.....	341,635,171	13,174,827,277
To other public service corporations	.....	.....	7,444,108,488	.....	.....	20,512,086	7,464,620,574
Other purposes (non-revenue)	.....	.....	821,522,389	.....	.....	9,951,558	831,473,947
Distribution and line losses	.....	.....	4,268,150,978	.....	.....	192,459,509	4,460,610,487
Per cent of total output, 1917:							
For light	.....	.....	14.9	.....	.....	54.2	16.5
For power	.....	.....	43.0	.....	.....	27.7	42.4
To other public service corporations	.....	.....	25.0	.....	.....	1.7	24.0
Other purposes (non-revenue)	.....	.....	2.8	.....	.....	0.8	2.7
Distribution and line losses	.....	.....	14.3	.....	.....	15.6	14.4

waste products from sawmills is available, all of which fuels can be profitably used in small stations.

That a large number of companies are not doing a strictly central-station business is indicated by the following table. Commonly the operations carried on with that of furnishing electric current are those of supplying water and producing gas or conducting a street railway enterprise.

	Plants
Electric and water service	1,328
Electric and gas service	206
Electric, gas and water service	32
Electric, gas and street railway	14
Electric and street railway	11
Electric, gas, water and street railway	6
Electric, water and street railway	4
Electric and miscellaneous business such as heating, manufacture of ice, mining, telephones, etc	1064

The development of hydro-electric stations at the time the census was taken is shown in Table 2. Hydro-electric stations comprised only 5.1 per cent of the total number of central generating plants, but they supplied 22 per cent of all municipalities supplied by generating stations. They represented almost half the investments in plant and equipment, received nearly one-third of the total income, incurred about one-third of the total

TABLE II—ALL GENERATING STATIONS AND HYDRO-ELECTRIC STATIONS COMPARED, 1917

	All Generating Stations—	Stations Reporting Water Power of 1,000 Horsepower and Over	
	Number or Amount	Number or Amount	Per Cent of Total
Number of plants	5,124	259	5.1
Number of separate generating stations	5,824	684	11.7
Number of cities, towns, etc., served by generating plants	11,364	2,497	22.0
Value of plant and equipment	$2,952,423,577	$1,396,619,224	47.3
Total income	$494,972,405	$157,580,682	31.8
Light, heat, and power, including free service	$471,063,414	$149,224,378	31.8
All other sources	$23,908,991	$8,356,304	35.0
Total expenses, including salaries and wages	$400,445,429	$125,027,197	31.2
Total number of persons employed	99,666	25,590	25.7
Total horsepower	12,875,522	5,867,447	45.6
Steam engines and steam turbines:			
Number	7,300	654	9.0
Horsepower	8,391,816	1,764,203	21.0
Water wheels and turbines:			
Number	3,358	1,995	59.4
Horsepower	4,274,479	4,092,882	95.8
Internal-combustion engines:			
Number	2,914	45	1.5
Horsepower	209,227	10,362	5.0
Kilowatt capacity of dynamos	8,943,423	3,954,294	44.2
Output of stations	29,807,378,386	16,018,906,990	53.7
Kilowatt-hours generated	25,438,303,272	13,924,464,619	54.7
Kilowatt-hours purchased	4,369,075,114	2,094,442,371	47.9
Kilowatt-hours sold	24,661,331,266	13,148,946,560	53.3
For light	4,772,277,255	1,120,506,702	23.5
For power	12,622,123,027	7,523,445,685	59.6
To other companies	7,266,930,984	4,504,994,173	62.0
Stationary motors served:			
Number	509,778	145,032	28.5
Horsepower	8,765,570	3,360,371	38.3
Number of customers	6,570,430	1,686,284	25.7

expenses and employed a little more than one-fourth of all employees in generating stations. While they sold 53.3 per cent of all current sold, their proportion of current for lighting was only 23.5 per cent, while the proportion sold for power and to other companies was 59.6 per cent and 62 per cent respectively. The lower rates obtained for hydro-electric current is reflected in the fact that while such stations supplied 53.3 per cent of all current sold, their income from the sale of current was only 31.8 per cent of the total. The hydro-electric plants of California reported more horsepower in the aggregate, 1,114,356, than any other state. New York ranked second, 822,224, followed by Michigan, 504,719.

An examination of the different types of prime movers shows that steam engines were being rapidly displaced by the larger and more efficient steam turbines. In 1917 steam engines furnished 13.2 per cent of the total horsepower of central stations, while steam turbines furnished 52.2 per cent and water wheels 33.1 per cent. Internal combustion engines reported to the number of 2,934, furnished only 1.6 per cent of the total horsepower.

As shown in Table I the gross capitalization of the electric light and power industry in the United States was $3,245,185,098, of which amount $127,375,200, or 3.9 per cent, represents the investment in municipal stations. The principal items entering into this total for commercial stations are capital stock, amounting to 50

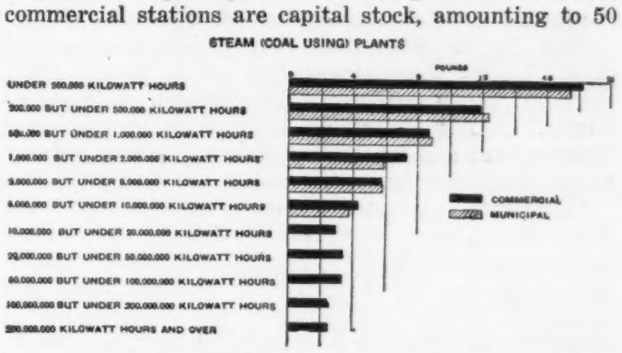

STEAM (COAL USING) PLANTS
POUNDS
UNDER 100,000 KILOWATT HOURS
100,000 BUT UNDER 500,000 KILOWATT HOURS
500,000 BUT UNDER 1,000,000 KILOWATT HOURS
1,000,000 BUT UNDER 2,000,000 KILOWATT HOURS
2,000,000 BUT UNDER 5,000,000 KILOWATT HOURS
5,000,000 BUT UNDER 10,000,000 KILOWATT HOURS
10,000,000 BUT UNDER 20,000,000 KILOWATT HOURS
20,000,000 BUT UNDER 50,000,000 KILOWATT HOURS
50,000,000 BUT UNDER 100,000,000 KILOWATT HOURS
100,000,000 BUT UNDER 200,000,000 KILOWATT HOURS
200,000,000 KILOWATT HOURS AND OVER
COMMERCIAL
MUNICIPAL

FIG. 1—NUMBER OF POUNDS OF COAL USED PER KILOWATT-HOUR GENERATED FOR COMMERCIAL AND MUNICIPAL STATIONS, 1917

per cent of their capitalization; bonds, to the extent of 41.7 per cent, and floating debt, amounting to 6.5 per cent. Cash investments, real estate mortgages and premium on securities issued amount together to only 1.8 per cent. A deduction of $313,539,988 for intercompany holdings, treasury securities and investments outside of electric light and power industry leaves a net capitalization of $2,804,269,910, equivalent to 95.6 per cent of the reported investment in plant and equipment.

It appears from Table III the average lighting rate for all plants in 1917 was 5.5 cents per kw.-hr. and the average power rate 1.2 cents per kw.-hr. The highest lighting rates were reported in New Mexico, 10.7, and North Dakota, 10 cents. The lowest lighting rates were reported by West Virginia, 3 cents. The highest average rates for power were reported by, in general, the same states that reported high lighting rates, North Dakota leading with 4.3 cents per kw.-hr., followed by New Mexico with 3.4 cents per kw.-hr. Several states reported an average power rate under 1 cent, the state of Montana being lowest with a power rate of only six-tenths of a cent. The average rates received by municipal plants for their current was much higher than those charged by commercial stations.

TABLE III—COMMERCIAL AND MUNICIPAL CENTRAL ELECTRIC STATIONS—AVERAGE RATE PER KILOWATT-HOUR, 1917 (CENTS)

	Total			Commercial			Municipal		
Division and State	Light	Power	Sold to Other Companies	Light	Power	Sold to Other Companies	Light	Power	Sold to Other Companies
United States	5.5	1.2	0.7	5.6	1.2	0.7	4.9	1.8	1.5
Geographic Divisions:									
New England	6.9	1.7	0.9	6.9	1.7	0.9	6.8	2.1	2.0
Middle Atlantic	5.6	0.9	0.8	5.6	1.0	0.8	5.8	2.6	2.7
East North Central	4.9	1.6	0.7	5.2	1.6	0.7	3.7	1.7	1.6
West North Central	5.9	1.4	0.6	5.6	1.4	0.6	7.6	2.3	4.0
South Atlantic	5.4	1.0	1.0	5.0	0.9	0.7	6.7	2.0	0.5
East South Central	5.5	1.4	0.3	5.2	1.3	0.3	6.7	2.1	1.0
West South Central	6.4	2.1	1.1	6.2	2.1	1.0	7.8	2.6	1.9
Mountain	6.5	0.8	0.5	6.6	0.8	0.5	5.5	2.0	2.0
Pacific	4.5	1.2	0.7	5.0	1.2	0.7	2.7	1.1	0.4

Readers' Views and Comments

After Eighteen Years

To the Editor of the ELECTRICAL WORLD:

SIR: In the ELECTRICAL WORLD AND ENGINEER of Aug. 16, 1902, there appeared an article by a youthful engineer entitled "Direct Measurement of Wattless Power." After discussing methods of power-factor measurement and the elusive quantity termed reactive power, the writer made the following comment:

"Education is largely a matter of sensual experience. What we see, touch or measure directly is always more easily understood than the results of deductive reasoning. After one has measured the apparent watts in a circuit, the true watts and the reactive watts, he has all three sides of his vector triangle in the flesh, as it were; and there is then no excuse for difficulty in interpreting the theory."

A method for measuring the reactive power directly in a balanced three-phase circuit was then developed, after which this paragraph followed:

"The method also suggests an application to commercial metering. It is generally conceded that a customer of a central station should be made to pay something for his wattless power in addition to the charge for the power he consumes. An integrating wattmeter connected so as to rotate at a speed proportional to $EI \sin \Theta$ will, in conjunction with the regular meter, furnish the data for a more equitable system of charging. Such a system can have but one result—better voltage regulation, due to the stimulus that will be given to the manufacture of high-power-factor motors. A high-power-factor motor will be placed on the market just as soon as the purchaser finds it to his advantage to pay the necessarily increased price. He will pay that price if by doing so his bills are reduced a sufficient amount."

The editors were so pleased with the suggestions thrown out in that article that they gave it a full-page editorial, but they took exception to the idea of selling reactive power as suggested. Here is what they said:

"Imagine the perplexity of the ordinary consumer operating an alternating-current motor, in addition to incandescent lamps, from a three-phase alternating-current distributing system of street mains, when he saw two meters on his premises, one of which showed the kilowatt-hours he really used, while the other showed the kilowatt-hours that passed into and out of his motor in rapid succession without his being able to capture and use them, but for which he was called upon to pay a certain percentage. Apart from the difficulty of getting him to understand the situation, there would be the difficulty of persuading him to pay for those 'wattless' kilowatt-hours that he did not convert and use mechanically. A better plan, and one in extended use, is to meter the lamps and the motors separately and charge a price per kilowatt-hour for motor consumption higher than that for lamps, in accordance with the added cost of the reactive power involved."

The following is quoted from an editorial in the ELECTRICAL WORLD of July 17, 1920:

"This problem can be solved, as pointed out in a past issue, by using, in addition to the ordinary three-phase active watt-hour meter, a special three-phase reactive watt-hour meter which integrates the total number of reactive watt-hours applied to the customer's load."

This letter is not written to register any claim of foresight, but rather to point out that the profession has been woefully slow on a subject that has long been of vital interest to the power-station manager.

Los Angeles, Cal. BUDD FRANKENFIELD.

[Our progress in engineering is largely based upon results of experience. In the late eighties a prominent engineer fought the introduction of alternating-current distribution with some justification on the basis that experience with the system did not favor such a radical move. Today such an argument would meet little sane consideration. The ELECTRICAL WORLD judges all matters in the light of results of experience and current engineering practice. The writer of this letter has noted a point where experience has justified a change in opinion.—EDITOR.]

The Three-Phase Four-Wire System

To the Editor of the ELECTRICAL WORLD:

SIR: While no one can deny the economy in copper obtained by making use of the three-phase four-wire system of distribution, some objections brought up by those considering its adoption should be carefully considered and given their proper value. Most of these objections are of an operating nature and seem to be connected with the overhead installation of the system. It should be determined if these objections are the manifestation of the natural inertia toward change, if they are the product of misinformation or are real and to what extent they should detract from the use of the three-phase four-wire system.

The three-phase four-wire system can be operated with the neutral wire either grounded or ungrounded. Adherents to both methods of operation can easily be found. If the neutral wire is grounded the presence of ground potential wire on the pole is said to increase the danger to the lineman who is working on the live line. This danger, however, does not seem very serious as linemen treat all primary wires as equally dangerous. With more reason it is feared that if an accidental ground connection is made by a lineman through a wet pole, a grounded transformer case or a lightning arrester ground, while working on the line wire he will cause a destructive short circuit. It might be well to note here that one of the greatest dangers to linemen is a congested pole; the three-phase four-wire system will handle the same load with less wires and therefore eliminate some congestion. A grounded system is also thought to increase the number of transformer bushing failures and to suffer more from the effects of lightning.

If the neutral wire is not grounded the safety of the lineman is the same as that of any other ungrounded system, while it is known that accidental grounding of one of the line wires will often result in potentials on the other wires of a magnitude sufficient to be destructive to transformer windings or protective devices.

Some accurate comparative data, compiled by a company having made the change from some system to a three-phase four-wire system and having operated the latter for some years, would be of great interest.

New York City. O. P. REY.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Standard Accessories That Must Be Furnished with Transformers

RULES for standard accessories which will be furnished with single-phase distribution transformers as adopted by the Electric Power Club to become effective Jan. 1, 1921, are shown in the accompanying table. This table gives specifications for primary voltages from 440 to 66,000, 60 cycle and 25 cycle. The accessories specified are thermometer, oil gage, oil drain valve, oil drain plug, oil sampling valve, provision for filter-press connection, hanger irons and cut-outs.

ACCESSORIES WHICH MUST BE FURNISHED WITH TRANSFORMERS OF DIFFERENT RATINGS

Voltage,	Cycles	*Size of Transformer (Kva.), Which Must Have Equipment Shown: Oil Drain Plug, Hanger Iron Cut-Out	Oil Drain Plug, Hanger Irons	Oil Drain Plug	Oil Gage, Oil Drain Valves, Oil Sample Valve, Filter Press Connection	† Thermometer Oil Gage, Oil Drain Valve, Oil Sample Valve, Filter Press Connection
440	60	0–10	11–50	51–100	150–249	250†
	25	0–10	11–25	26–50	75–149	150†
550	60	0–15	16–50	51–100	150–249	250†
	25	0–15	16–25	25–50	75–149	150†
‡2,300	60	0–50	.....	51–100	150–249	250†
	25	‡	.....	‡	75–149	150†
4,600, 6,600 and 13,200	0	....	0–50	51–100	150–249	250†
	25	....	0–25	26–50	75–149	150†
22,000 to 66,000	60	....	.....	0–37.5	50–249	250†
	25	....	.....	0–15	25–149	150†

* With a transformer of special rating such accessories will be regularly furnished as would be supplied with a transformer of standard rating using the same mechanical parts.

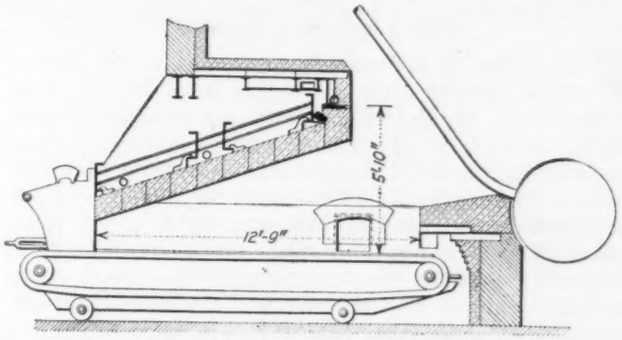
†Plain standard indicating thermometers will be furnished for the transformers as listed, except that indicating thermometers with alarm contacts will be furnished with self-cooled transformers 1,000 kva. and above, and with all water-cooled transformers.

‡ With 2,300-volt, 25-cycle transformers of 0–25-kva. rating, hanger irons only are required, and with those of 26-50-kva. rating oil drain plugs and cut-outs are required.

Lignite Containing 23 per Cent Moisture Develops 275 per Cent Boiler Rating

SIXTY pounds of lignite containing 23 per cent of moisture are burned per square foot of grate area per hour in the Platte Street Station of the Denver (Col.) Tramway Company at 250 to 300 per cent of boiler rating. These unusual results are due to some unusual operating features, to suitability of furnace design and to intelligent supervision. The station is operated on a bonus system, which creates an interest from the operators which is reflected in the results, but two other features of operation are mainly responsible for this excellent performance. One is the exclusion of air around the stoker gate and even through the coal in the stoker hopper. The stoker hopper is fed by coal spouts and the hopper is provided with a covering fitting around the spouts. The other unusual procedure is the use of preheated air under the stokers. This air is exhausted from the generators and is delivered under the grates at 80 deg. F. (27 deg. C.).

An analysis of the fuel and the performance of the plant is shown in the accompanying table. The fuel is Leyden lignite and is mined in Jefferson County, Colorado. Wet as this fuel is when mined, it is found to be desirable to moisten it still more until it contains



THIS ARRANGEMENT IS USED FOR VERY WET COAL

Lignite containing 23 per cent moisture burned in this furnace at 60 lb. per hr. per sq.ft. of grate.

about 23 per cent of moisture. This is done by sprinkling the coal just before it goes to the crusher. Approximately 5 per cent moisture is added in this manner. The furnace design is especially suited to this class of work. The boilers are six Class O, No. 29, Stirling type, each having 7,267 sq.ft. (225 sq.m.) of heating surface. Each boiler is fired by two Green "K" type chain grates each 6.5 ft. (2 m.) wide by 13 ft. (4 m.) long, having a combined grate area of 165 sq.ft. (15.3 sq.m.) and a 1-to-44 ratio of grate surface to heating surface.

It will be noted from the sectional side elevation of the furnace shown in the drawing that the stokers are long and that the furnace has a very long igniting arch, 10 ft. (3 m.) horizontal dimension. The arch is pitched at 4 in. per foot (30 cm. per m.) to reflect the heat up to the stoker gate as ignition of this high moisture fuel is one of the most important considerations. The furnace has 4.7 cu.ft. for each square foot of grate area (1.4 cu.m. per sq.m.), which would be enlarged if the installation were being made today. The

ANALYSIS AND PERFORMANCE OF HIGH-MOISTURE LIGNITE

Coal burned	Leyden (Col.) lignite
Proximate analysis:	
Moisture, per cent	23.08
Volatile matter, per cent	32.43
Fixed carbon, per cent	32.07
Ash, per cent	12.42
Sulphur, per cent	0.20
B.t.u. per pound as fired	8,865
Combustible in ash, per cent	10.68
CO_2 at damper, per cent	15.00
Boiler horsepower developed per blower	1,920
Per cent rating	273.00
Horsepower developed per sq.ft. grate surface	11.60
Kilowatt-hours generated at 14 lb. water rate	8,200
Kilowatt-hours per rated boiler horsepower	5.83
Coal per square foot of grate surface per hour	60.90

units are equipped with Stirling superheaters and served by individual induced-draft fans with variable-speed motors, drawing through economizers. The use of induced draft at altitudes of one mile or more is desirable and becomes practically necessary when economizers are used.

The thickness of fuel bed carried is 10 in. (25 cm.), which gives a substantial bed on the grate, ready to meet sudden demands for steam by simply increasing the draft and stoker speed.

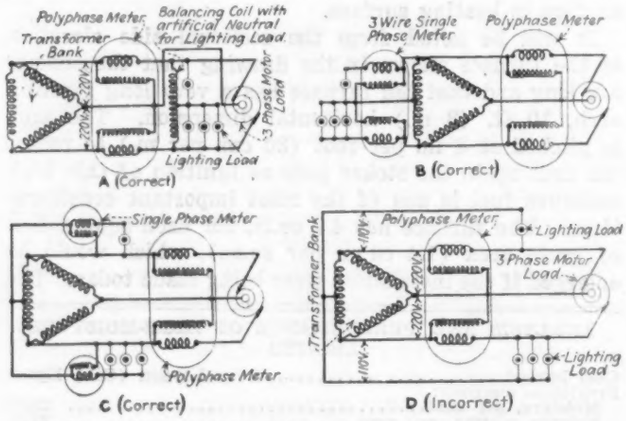
The boilers frequently carry from 250 to 300 per cent rating, and 60 lb. (27 kg.) of this fuel can be burned per square foot of grate surface per hour, which is an unusually high combustion rate with such high-moisture fuel.

Methods of Metering Combined Power and Lighting Loads

FOR metering three-phase power loads and single-phase lighting loads which are fed from the same transformer the correct methods of connecting are shown in the accompanying drawings. About the most satisfactory method (shown in *A*) makes use of a balance coil connected between two of the phases with an artificial neutral for the three-wire lighting. A polyphase meter is connected up to the circuit in the manner ordinarily used for measuring three-phase loads. The measurements of this meter will be accurate for any condition of unbalanced load on the lighting circuit or on the power circuit. This method has another advantage in that only one maximum-demand meter need be used for both power and light.

In the method shown at *B* the neutral for the lighting circuit is taken from the middle tap of one of the transformers. A three-wire, single-phase watt-hour meter is used for metering the lighting energy and a polyphase meter is used for the motor load. With the system shown in *C* two single-phase meters and one polyphase meter are employed respectively for the lighting load and the power load.

Another system of connecting which is incorrect but which might be used is shown in *D*. Only one meter



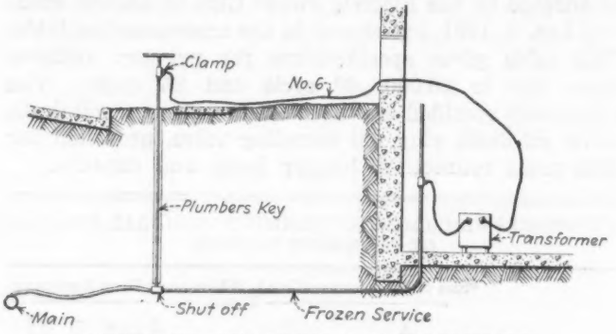
CORRECT AND INCORRECT METHODS OF METERING POWER LOADS AND LIGHTING LOADS

is used with this connection, and the neutral of the lighting circuit is taken off the middle point of one of the transformers. However, with this system, any unbalance in lighting load will give incorrect meter readings.

M. F. SMALLEY,
Meter Superintendent.
Ohio Power Company,
Newark, Ohio.

Pipe-Thawing Outfit for the Coming Winter

A PIPE-THAWING outfit which can be operated from a 110-volt or 220-volt house service has been developed that may be operated safely without requiring great skill. The equipment consists of a 1.5-kva. transformer having 110-volt and 220-volt primary windings and a 16-volt secondary, 100 ft. to 125 ft. (30 m. to 35 m.) of No. 6 weatherproof copper wire in pairs for the secondary connections and 50 ft. (15 m.) of No. 14 drop cord for the primary connections. The current supply is obtained from a connection at the entrance cabinet of the house-lighting service, using the 220-volt connection where the service is three-wire. One secondary connection is made to the water pipe in the building and the other by means of a plumber's key attached to the shut-off cock at the street end of the service pipe.



CURRENT FOR THIS OUTFIT IS TAKEN FROM THE HOUSE SERVICE

The transformer capacity of 1½ kva. has been found sufficient for ¾-in. (18-mm.) and 1-in. (25-mm.) iron and lead service pipes. The thawing time ordinarily ranges from ten to thirty minutes, which compares favorably with the former method using a 10-kva. to 15-kva. transformer connected to the 2,200-volt primary circuit. Should the service be frozen between the shut-off and the main the connection may be made to a neighboring shut-off.

The transformer used is of the ordinary core type having a core made of sheets of stovepipe iron. The laminations are 1⅜ in. x 6⅜ in. (4.6 cm. x 17.1 cm.) and 1⅜ in. x 9⅜ in. (4.6 cm. x 24.7 cm.). The core is built up to a cross-section of 1⅜ in. x 1⅜ in. (4.6 cm. x 4.6 cm.), with the laminations dovetailing at the corners in groups of five. The opening through the core is 5 in. x 8 in. (12.7 cm. x 20.3 cm.). The primary winding consists of 520 turns of No. 12 magnet wire divided into two windings of 260 turns for paralleling when using 110 volts on the primary. The two halves of the primary winding are placed in series when using 220 volts. The secondary is made of 38 turns of No. 1 bare copper wire. The transformer is air-cooled and is mounted in a wooden case with a hole left through the box so that additional secondary turns may be threaded through to vary the secondary voltage if required. The complete transformer is 8½ in. x 14 in. x 13½ in. high (21.6 cm. x 35.5 cm. x 34.3 cm.) and weighs about 55 lb. (25 kg.).

The current depends upon the resistance of the service pipe, usually 80 amp. to 110 amp. on the secondary side and 11 amp. to 16 amp. on the primary.

H. S. RUSH,
Associate Professor of Electrical Engineering.
State School of Science,
Wahpeton, N. D.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Industrial Tractor Economies

ON THE docks at Seattle, Wash., electric tractors have been effective when used to move loaded trailers, the average load in one case being five 225-lb. (116-kg.) cases moved a distance of 120 ft. (36 m.) every 2.35 minutes. Five men are required for loading and two on the tractor. With the same equipment fifty-five 310-lb. (140 kg.) cases were moved 600 ft. (180 m.) in an average time of 4.55 minutes per trip. The docks were snow-covered at the time.

The American Steel & Wire Company has been able to operate Edison battery tractors more than twenty hours a day by charging them at twice normal rate one-half hour four times per day. Once a week a full charge is given. One tractor made 859 trips, covering a one-way distance of 812 ft. (358 m.) with an average load of 2¼ tons (2 metric tons), returning empty, with a total input to the battery of 138 kw.-hr.

At the Akron plant of the Goodyear Rubber Company four tractors replaced sixteen men who were required to move 1,258,000 lb. (570,000 kg.) of material during an eight-hour shift. The man-power cost was $74 against $40 with tractors. By the use of spare batteries it was possible to operate the tractors twenty-four hours a day, and when the plant was working three shifts the four tractors saved the company $102 per day.

Chart for Easy Determination of Direct-Current Line Drop

FOR quickly determining any one of the factors, voltage drop, length of line, wire size and amperes, in a direct-current line the diagram shown here will prove useful. The accompanying table indicates briefly the method to follow in using the chart. For instance, to determine the voltage drop in a No. 10 conductor carrying 5 amp. a distance of 400 ft. (120 m.). According to the table, it is necessary to follow from the point on the right-hand side of the chart where the No. 10 wire size is indicated horizontally to the diagonal line marked 5 amp. From this point follow vertically down to the diagonal line marked 400 ft. From this point follow horizontally to the voltage scale on the right, where the voltage drop is seen to be 2 volts. The other calculations are made in a similar manner. It must be noted that this chart is compiled for a single conductor, and that with a two-wire circuit the total length of single conductor must be used. When using wire sizes No. 0000 to No. 9 inclusive, which are listed in the right-hand column, all values in the "drop in volts" column should be divided by ten.

FOR USE WITH CHART TO DETERMINE VOLTAGE DROP, ETC.

To Find Unknown Factor	Follow from	Horizontally to	Vertically to	Horizontally to
Voltage drop...	Size wire	Amperes	Length	Voltage drop
Length circuit.	Size wire	Amperes	Voltage drop	Length
Size wire.....	Voltage drop	Length	Amperes	Size wire
Amperes.....	Voltage drop	Length	Size wire	Amperes

The range of the chart can be increased to an almost unlimited extent by remembering the following rules: First, all values in both columns representing amperes and drop in volts may be either multiplied or divided by ten or any multiple of ten; second, all values in both columns representing hundreds of feet and drop in volts may be either multiplied or divided by ten or any multiple of ten; third, if the values in the columns representing hundreds of feet and amperes are both multiplied or divided by ten or a multiple of ten, then the values in the drop in volts column must likewise be multiplied or divided by the product of the other two multipliers or divisors.

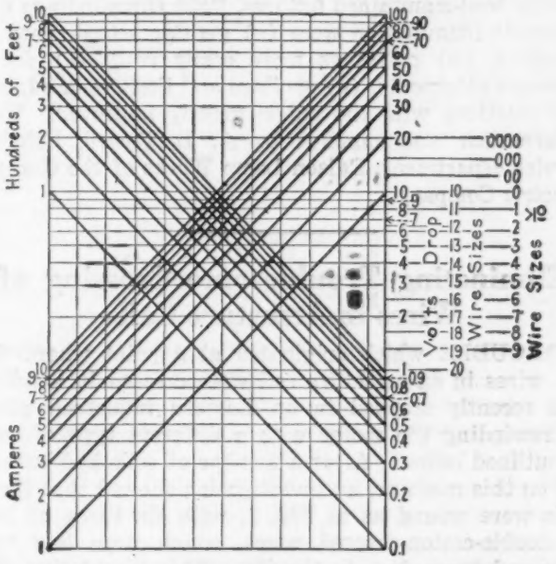


CHART FOR DETERMINING VOLTAGE DROP IN DIRECT-CURRENT CIRCUITS

The chart may be extended for wire sizes not shown. For instance, if wire smaller than No. 20 is used the column may be filled in from No. 20 to the bottom of the chart. The spacing will be the same as the sizes from No. 10 to No. 20, and No. 30 will come opposite the bottom of the chart. The larger sizes may be filled in at the top of the chart.

This chart is not absolutely accurate as slight errors have been permitted in order to gain uniformity, but in only one case does such an error exceed 2 per cent, which is close enough for a chart of this kind. The values from which this chart was constructed were taken from Circular 31, Bureau of Standards, 1914 edition, for B. & S. gage copper wire at a temperature of 20 deg. C., or 68 deg. Fahr.

L. J. VOORHEES.

New York, N. Y.

Pier Illumination Requires Far More Attention to Surrounding Surfaces

OF FIFTY-EIGHT large steamship piers which have been inspected, 42.6 per cent had illumination which was entirely inadequate and generally poor, 51.2 per cent had fair illumination and only 6.2 per cent had good illumination. The average watts per square foot of these electrically lighted piers was 0.16, varying from a minimum of 0.05 watt to a maximum of 0.34 watt. Very much better illumination results would have been obtained in nearly every case had the equipment been well maintained and the surroundings occasionally painted with white or other light paint. Only 3.6 per cent of the piers had white walls and ceilings; 9.1 per cent light-colored surroundings, 20 per cent medium-colored, 52.8 per cent dark, and 14.5 per cent very dark (almost black).

The results of the better conditions in those piers having well-maintained fixtures, light surroundings and adequate illumination were (a) greater actual speed of trucking, (b) markings more easily read, (c) fewer mis-sent shipments, (d) spoilage and theft reduced, and (e) relations with the public greatly improved. This information was supplied by A. L. Powell, lighting service department, Edison Lamp Works of the General Electric Company.

Eliminating Troublesome Crossing of Wires in Armature Coils

TROUBLE which originated at a point where the wires in an armature coil were crossed in winding was recently stopped in an Eastern industrial plant by rewinding the motor with a different type of coil, as outlined below: After a number of coils had burned out on this machine, an investigation showed that these coils were wound as in Fig. 1, with six turns of No. 12 double-cotton-covered wires, which were laid two wide and three deep in the slot. This meant that the wire had to be crossed when winding. These crossovers had been made at the nose of the coils at the lead end, the coil having been wound on a shuttle and pulled into shape. The inspection indicated that when the coils were put in the armature the wires had been pounded at this point, weakening the insulation so that the winding was later short-circuited. As the machine was wound on a single-parallel four-circuit progressive lap winding (Fig. 1), in order to eliminate the crossovers it was decided to rewind the motor with a single-series progressive wave winding, using two No. 12 d.c.c. wires wound in coils of three turns each. In such a coil, as both wires are in parallel, no crossing over is necessary. As the motor was changed from a parallel to a series winding and the two No. 12 wires were used in place of the one No. 12, the voltage of the machine remained the same. Since the motor was reconnected as shown in Fig. 2, it has been operating satisfactorily for more than a year without any trouble.

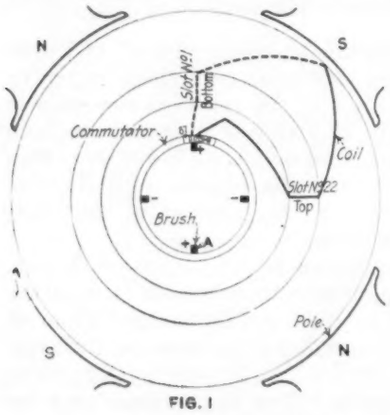


FIG. 1

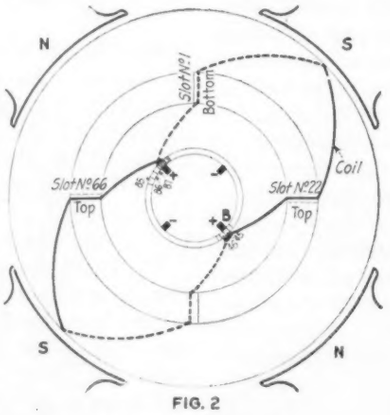


FIG. 2

TROUBLE FROM CROSSED WIRES IN SIX-TURN COIL STOPPED BY SUBSTITUTING THREE-TURN COIL

Bronx, N. Y. C. A. JOHNSON.

Starting a Synchronous Motor Without Starting Equipment

TO START a 250-hp. synchronous motor after its starting motor had been removed, the writer recently employed a method which consisted in turning over the motor by hand while energy was supplied to it from a generator which was slowly brought up to speed from standstill.

This 2,200-volt synchronous motor is used to drive a stamp battery in a large cyanide mill connected with a silver mine in Central America. An accident resulting in the burn-out of a 25-hp. motor driving some essential part of the mill machinery necessitated the temporary use of the 35-hp. starting motor belonging to the synchronous motor. Barring accidents, it was not anticipated that this would cause any inconvenience, since the stamps are in operation continuously and the synchronous motor is rarely shut down.

However, about three days after the change had been made and before the 25-hp. motor could be rewound, a broken stamp battery belt required the shutdown of the synchronous motor. To get the starting motor back into place would have taken three hours and would have left the mill without the section that the starting motor was then driving. To change the motor back and forth would have entailed a loss of from six to eight hours. Therefore the following course was taken. All load was taken off the two Pelton wheel hydro-electric plants which drive the mill and mine compressor, and both of them were shut down. The synchronous motor and a generator in one of the plants were then tied together by closing their respective oil switches. About ten men were then put on the belt of the synchronous motor and set to turning it as fast as possible. The generator was simultaneously started up, the field rheostat and the exciter rheostat of both the generator and the motor being carefully adjusted as the speed increased by watching the indicating instruments. Before the men turning the synchronous motor realized it the motor was turning under its own power. As soon as this fact was signaled to the power plant the generator speed and voltage were gradually brought up to normal, after which the other power plant and rest of the mill and compressor plant were again put in operation. By skillful handling the total time lost was less than an hour.

FREDERICK KRUG.

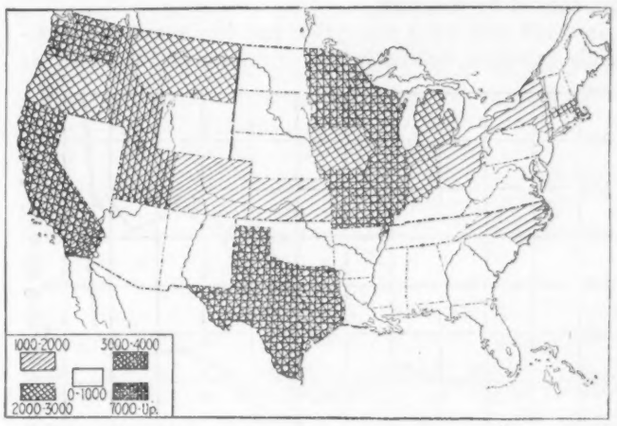
San Juancito, Honduras, C. A.

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

Market for 75,000 Electric Ranges in United States

ACCORDING to data compiled by the National Electric Light Association, there are at the present time about 75,000 electric ranges in use in the United States as compared with only about 10,000 in use in 1915. The map reproduced herewith shows the relative density of electric ranges in use by the states. It will be seen that



DISTRIBUTION OF ELECTRIC RANGES

the range has been generally adopted throughout the country and that its use is not confined to any one section. A conservative estimate shows a possible market during 1920 for approximately 75,000 ranges. Whether this figure will be reached depends largely upon the central stations' ability to finance the additional investment in line and transformer capacity required.

Comparative Costs of Central-Station and Oil-Engine Power

AS THE fuel cost of a private oil-engine plant is quite low, ranging, with the price of oil at 5 cents per gallon, from 4.3 mills to 6 mills per kilowatt-hour, the installation of an oil engine in preference to central-station power is sometimes considered. Some interesting data comparing the operating cost of an oil engine with purchased central-station power are given by W. H. Feldmann of the Consolidated Gas, Electric Light & Power Company of Baltimore.

The economy of oil consumption per brake-horsepower-hour or kilowatt-hour varies with the type and make of engine. However, it is safe to assume an economy of 0.45 lb. oil per brake-horsepower-hour with the Diesel type, and in the larger sizes of the semi-Diesel type 0.6 lb. oil per brake-horsepower-hour is a good figure to use. One oil-engine manufacturer makes the following guarantees on a semi-Diesel-type engine, the fuel oil to have a heat value of not less than 18,000 B.t.u. per pound and contain not less than 1 per cent of water:

Per Cent Load	Lb. Oil per Brake Hp.-Hr.
100	0.49
75	0.49
50	0.57

Several engines of this type installed in a Baltimore factory show that while these efficiencies are obtained when the carbon has been removed from the cylinders and the valves are well ground in, there is a falling off when the engines have been in operation a short time. Numerous tests of similar engines confirm the figure of approximately 10 kw.-hr. per gallon of oil with semi-Diesel engines of about 200 hp.

The fixed costs of an oil-engine plant by far exceed those of plants using other prime movers owing to the high cost of the engine, lack of overload capacity and also to a higher depreciation rate. A quotation recently received from an oil-engine manufacturer on a 360-hp. Diesel horizontal oil engine with twin cylinders is $35,810, f.o.b. factory, and therefore the flat figure of $100 per horsepower can be safely assumed for all engines of approximately this size. Installation charges are correspondingly high, as a very substantial foundation must be provided to eliminate vibration. The price of $100 per horsepower applies only to the engine. Tanks, oil pumps and necessary piping must also be provided.

Oil-engine supporters freely admit an annual depreciation of 8 per cent, and it is not uncommon in connection with estimates of cost of operation of oil-engine plants to use 12 per cent. The depreciation rate of 10 per cent should be adequate, however, and can easily be justified by an investigation of existing plants. It should be expected that the cylinders of an oil engine will wear very rapidly and must be rebored every three years when running under a continuous load. Maintenance records of an oil-engine plant having three 125-hp., two-cylinder semi-Diesel-type engines show that in three years two cylinder heads costing $400 each were broken, three crank shafts were broken and thirteen crank pin bearings were burned out. In this particular plant it is necessary to grind the valves and clean out carbon every two months.

In view of these conditions it would seem advisable to provide for maintenance charges an amount of 1 per cent of the cost of the engine, which may be more than necessary during the first years of operation but will certainly be required after the engine has been in operation for several years.

Because of the high cost of an oil engine and the troubles to which it is subject, it is necessary to provide labor of the highest type, for economy in this branch of the operating cost of the plant will result in higher maintenance charges and more rapid depreciation.

The ideal load for an oil-engine plant is constant and for a long period of the day, as the engine operates at highest efficiency with constant full load, and because of the large investment the engine should not remain idle many hours of the day. However, a drawback to the advantage to be gained by twenty to twenty-four hours' operation per day is the fact that duplicate equipment must be provided to permit necessary cleaning and repairing.

INVESTMENT AND YEARLY COST OF OIL ENGINE PLANT OPERATING TEN HOURS DAILY WITH MAXIMUM LOAD OF 200 KW. AND 25 PER CENT DAILY LOAD FACTOR

Investments	Oil Plant	Central-Station Service
One 360-hp. twin-cylinder Diesel oil engine	$35,810.00	
One 250-kw. direct-connected alternator with belted exciter	5,325.00	
Oil tanks	1,500.00	
Foundations, installation charges, building alterations and piping	6,000.00	
Wiring	500.00	
	$49,135.00	
Yearly Operating Costs		
Interest at 6 per cent on $49,135.00	$2,948.10	
Depreciation at 10 per cent on $49,135.00	4,913.50	
Insurance and taxes at 2 per cent on $49,135.00	982.70	
Fuel oil, 331,200 kw.-hr. ÷ 12 = 27,600 gallons at 5 cents	1,380.00	
One chief engineer at $50 per week	2,600.00	
One helper at $30 per week	1,560.00	
1,300 gal. lubricating oil at 50 cents	650.00	
Cooling water	541.00	
Waste and supplies	300.00	
Repairs, 1 per cent	358.10	
Breakdown electric service (used three times per year)	1,905.00	
Electric power purchased		$10,876.80
Total cost	$18,138.40	$10,876.80
Cost per kilowatt-hour	0.0547	0.0328

The accompanying tabulation of costs is based on the operation of an average plant for ten hours per day. The cost of energy generated by the oil plant is 5.47 cents per kilowat-hour, while purchased power would cost only 3.28 cents per kilowatt-hour, showing that energy generated by the oil-engine outfit costs 60 per cent more than central-station service. It should be noted that no profit is expected from the investment and no rental of space occupied has been charged.

These cost comparisons were made for normal times—that is, when oil was approximately 5 cents per gallon—and of course the present price of 12½ to 15 cents would still further widen the gap between costs. While the present price of oil is probably not the figure to be quoted in the future, yet it shows the instability of the oil market, in marked contrast with the more stable costs of power offered by central stations.

Thus at the present state of development of the oil engine and with the uncertainty of the oil market this type of prime mover cannot compete with central-station service, and it can be reasonably expected that power rates will more than keep pace with future oil-engine developments.

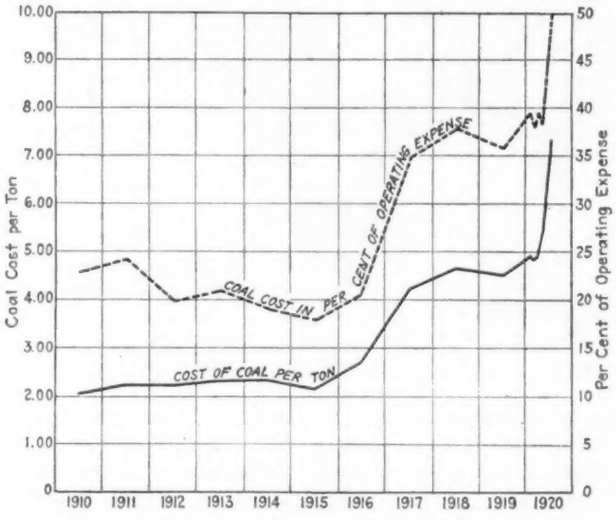
Denver Company Plans Another Record Vacuum-Cleaner Campaign

AS A RESULT of its summer vacuum-cleaner campaign conducted during the month of June, the Denver (Col.) Gas & Electric Company sold 960 Hoover sweepers in thirty days. Clare N. Stannard, secretary and commercial manager, reports that at least 1,500 could have been sold during the campaign had it been possible to secure the sweepers for immediate delivery. This company has been very successful in its vacuum-cleaner campaigns, which are conducted in the spring and fall. During the fall drive last year 1,015 sweepers were sold, bringing the total number connected to the company's lines up to about 12,000. This year the fall campaign is planned for September, when the bogie set is to sell twice the number of cleaners sold in any previous campaign and realize the schedule set by the Hoover company of two cleaners per thousand inhabitants in thirty days.

Ratio of Coal Cost to Total Operating Expenses

IN THE accompanying curves is shown the relation between fuel cost and total operating expense of the Detroit Edison Company during the past ten years. The cost of fuel per ton from 1910 to 1915, the first five years of the period, remained practically stationary, as shown by the solid curve. During the years 1916-1917 the price of coal rose steadily owing to labor shortage, inadequate transportation facilities and general inflation caused by the war.

In 1918 and 1919 the price per ton remained practically constant, but with the beginning of 1920 another sudden increase in price occurred, caused by the switchmen's strike and an increased demand for export purposes.



CURVES SHOWING RELATION OF COAL COST TO OPERATING EXPENSES

The broken line shows the percentage relation of coal cost to operating expense. In the period 1910-1915 this percentage line slopes slightly downward as new equipment and improved methods caused a decrease in the amount of coal required to produce a unit of energy. From 1915 to 1920 the broken line follows the same course as the solid line owing to the same cause in increased cost of coal.

When considered in terms of actual quantities these relations become more significant. While 80,900 tons sufficed for the needs of the company in 1906, the coal consumption had climbed to 450,400 tons in 1915 and to 975,800 tons in 1919. In the first six months of the present year 643,100 tons were used, being on the basis of 1,268,000 tons for the full year. In price the coal has increased from $2.21 per ton in 1915 to $7.37 per ton in June, 1920, or an increase of 233 per cent. The coal used by the Detroit Edison Company in 1920 will cost about $5,300,000 more than the same amount of coal would have cost in 1915.

Growth of Sales Managers' Association Last Ten Years

AT THE 1920 convention of the Sales Managers' Association, held at Association Island, N. Y., July 12 to 14, R. S. Hale, superintendent special research department, Edison Electric Illuminating Company of Boston, reviewed the growth of that organization during the last ten years. An abstract of his remarks follows:

"The idea of the Sales Managers' Association was started in the winter of 1909-10, when the growth of the electrical industry and of the National Electric Light Association and of the Association of Edison Illuminating Companies began to indicate the need of specialization. The Commercial Section of the N. E. L. A. was one development, but the Commercial Section took in companies of all sizes, while the sales managers of the very large companies were finding that each of them had some problems similar to the problems of the other large companies but quite different from the problems that formed the subject of the papers and discussions at the N. E. L. A. conventions. The idea then occurred to the writer, and undoubtedly to others at the same time, that a small convention, almost small enough for the delegates to sit around a table as at a committee meeting, would be of great value. The sales managers of the big companies found themselves getting together in groups at the big conventions, but so much else was going on that the discussions were left unfinished.

"After talking the matter over with the sales managers of the different companies the writer took it upon himself to initiate and plan for a small convention of sales managers only, and from the large companies only, with the hope that if the plan were successful it would be continued in later years. The first convention was called to meet at Briarcliff, N. Y., on July 11, 1910, and the following companies were represented: Edison Electric Illuminating Company of Boston, Detroit Edison Company, Commonwealth Edison Company of Chicago, Philadelphia Electric Company, United Electric Light Company of New York, Edison Electric Illuminating Company of Brooklyn, New York Edison Company and Cleveland Electric Illuminating Company.

"The meeting was so successful that a committee was appointed to arrange for continuing such gatherings. As a result the second convention was held at Briarcliff, July 10 and 11, 1911, with the following additional companies: Union Electric Light & Power Company of St. Louis, Consolidated Gas, Electric Light & Power Company of Baltimore, Potomac Electric Company of Washington, General Electric Company of Minneapolis and Seattle Electric Company.

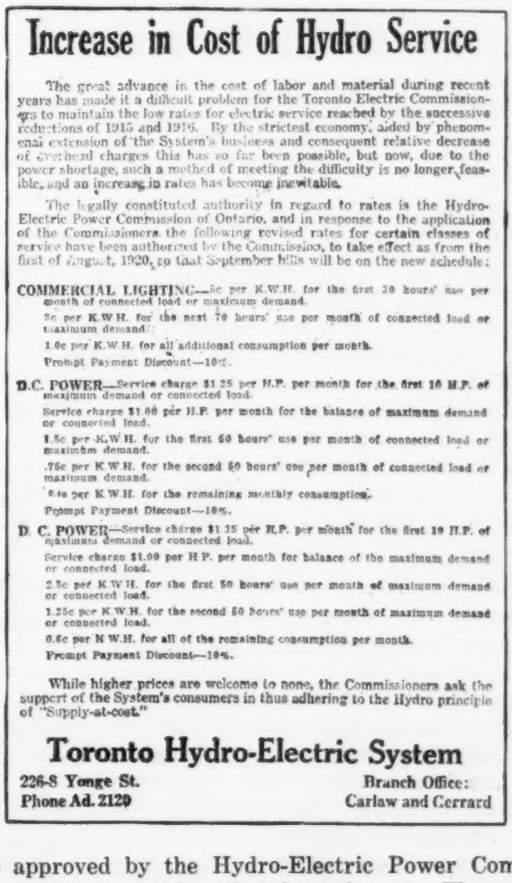
"In 1912 the convention was invited to meet at Association Island, N. Y., and met on Aug. 5, 6 and 7. The two Western companies, Seattle and Minneapolis, omitted to send delegates, but the Toronto Electric Company was a welcome addition. In 1913 the convention again met at the island. The Toronto Electric Company has dropped out, but the Union Gas & Electric Company of Cincinnati and the Public Service Company of New Jersey were represented for the first time. In 1914 the convention was again held at the island under the direction of E. W. Lloyd. In 1915 A. A. Pope was chairman and the convention held at York Cliff. Me. The New York & Queens County Electric Light & Power Company was a welcome addition to the membership. In 1916 J. D. Israel was chairman and the convention was held again at Association Island. The Public Service Company of Northern Illinois was a new number, making fourteen in all.

"At that convention Mr. Beardslee of St. Louis was chosen chairman for 1917, but on account of the war no conventions were held in 1917 and 1918. In the winter of 1918-19, as Mr. Beardslee had left the St. Louis company, Mr. Becker of the New York Edison Company was appointed chairman for 1919 and very ably got the association together again at Association Island. In 1920 the convention was held at the island under the direction of T. I. Jones of Brooklyn, and at its close R. H. Tillman of Baltimore was elected chairman for 1921, with R. R. Young of New Jersey and E. A. Edkins of Chicago on the executive committee.

At this convention the idea of having a formal constitution and bylaws was discussed, but the rule followed up to that time was maintained in force—that the chairman and his executive committee can do anything they choose until their successors are elected, but that in fact they will arrange the program so that the convention will continue to follow the methods of the past."

Toronto Hydro-Electric System Increases Rates

AS A RESULT of the continued high cost of labor and electrical equipment the Toronto Hydro-Electric System has been forced to increase its rates for commercial lighting and power. The increased rates were approved by the Hydro-Electric Power Commission of Ontario to take effect from Aug. 1. The accompanying announcement was issued by the Toronto Hydro-Electric System.



Increase in Cost of Hydro Service

The great advance in the cost of labor and material during recent years has made it a difficult problem for the Toronto Electric Commissioners to maintain the low rates for electric service reached by the successive reductions of 1915 and 1916. By the strictest economy, aided by phenomenal extension of the System's business and consequent relative decrease of overhead charges this has so far been possible, but now, due to the power shortage, such a method of meeting the difficulty is no longer feasible, and an increase in rates has become inevitable.

The legally constituted authority in regard to rates is the Hydro-Electric Power Commission of Ontario, and in response to the application of the Commissioners the following revised rates for certain classes of service have been authorized by the Commission, to take effect as from the first of August, 1920, so that September bills will be on the new schedule:

COMMERCIAL LIGHTING—8c per K.W.H. for the first 30 hours' use per month of connected load or maximum demand.
8c per K.W.H. for the next 70 hours' use per month of connected load or maximum demand.
1.0c per K.W.H. for all additional consumption per month.
Prompt Payment Discount—10%.

D.C. POWER—Service charge $1.25 per H.P. per month for the first 10 H.P. of maximum demand or connected load.
Service charge $1.00 per H.P. per month for the balance of maximum demand or connected load.
1.5c per K.W.H. for the first 50 hours' use per month of connected load or maximum demand.
.75c per K.W.H. for the second 50 hours' use per month of connected load or maximum demand.
0.4c per K.W.H. for the remaining monthly consumption.
Prompt Payment Discount—10%.

D. C. POWER—Service charge $1.25 per H.P. per month for the first 10 H.P. of maximum demand or connected load.
Service charge $1.00 per H.P. per month for balance of the maximum demand or connected load.
2.5c per K.W.H. for the first 50 hours' use per month of maximum demand or connected load.
1.25c per K.W.H. for the second 50 hours' use per month of maximum demand or connected load.
0.6c per K.W.H. for all of the remaining consumption per month.
Prompt Payment Discount—10%.

While higher prices are welcome to none, the Commissioners ask the support of the System's consumers in thus adhering to the Hydro principle of "Supply-at-cost."

Toronto Hydro-Electric System

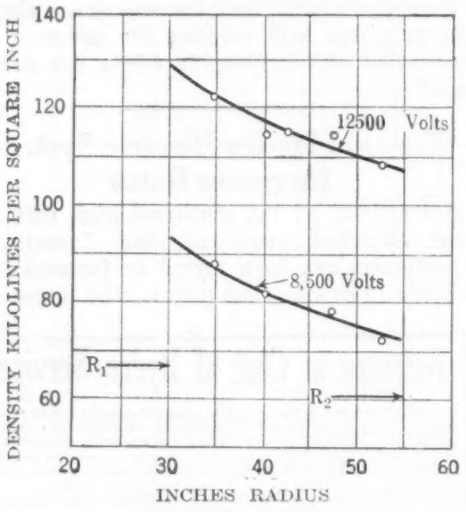
226-8 Yonge St. Phone Ad. 2120 — Branch Office: Carlaw and Gerrard

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
of the World

Motors, Generators and Transformers

Flux Distribution in the Core of a Turbo-Alternator.—CARL J. FECHHEIMER.—Tests were made on an axially ventilated alternator. Thus in the center there are axial holes at different radii, and single insulated conductors were inserted in one of each of the various groups of holes. A voltmeter and an oscillograph were connected to the terminals of each of these conductors in turn, and by means of this arrangement the voltages, as well as the wave forms of the voltage, at various depths of



VARIATION IN FLUX DENSITY WITH DEPTH OF CORE OF AN ALTERNATOR

core were determined. The normal voltage of the generator is 11,000, but oscillograms were taken with the terminal voltages of 8,500, 10,000 and 12,500, all at no load. The variation of flux density through the stator core is shown in the accompanying curves, and it is interesting to note that there is comparatively small change in density with the depth, even with negligible saturation, as at 8,500 volts. Much of the flux reaches the back of the core, even though the length of its path is considerably longer than at the inner radius.—*Journal A. I. E. E.*, July, 1920.

Generation, Transmission and Distribution

Losses in Electric Networks.—R. CAPRARO.—The relations between earth impedance and earth voltages, currents and losses in electric networks are studied. With the basis of experiment on a three-phase high-tension system, the author describes a method for controlling, discovering and localizing insulation defects, for the determination of the impedance between neutral and earth and for calculating overvoltages that may be developed.—*Technical Review*, July 20, 1920. (Abstracted from *Elettrotecnica*, Feb. 25, 1920.)

Tidal Water-Power Stations.—G. MANGIN.—One of the chief difficulties in the way of an economical harnessing of tidal motions of the seas is the pronounced periodicity of water supply and the resulting necessity to shut down the plants entirely during one to three hours four times every day. The author, however, shows that by electrically connecting two tidal plants so situated that the tidal motions are displaced with respect to time one plant may be made to supplement the other so that no interruptions need occur. Two such tandem plants could be built in France, one in the neighborhood of Brest, the other at St. Malo, and the article gives a rather detailed discussion of this interesting project. The interconnecting line would be about 200 km. (124 miles). It is shown on tidal diagrams how completely the two plants would co-operate, but owing to slight irregularities in the tide, there would be during twenty days in the year brief periods, of one or two hours at most, when both stations would be short of water simultaneously. If the tandem system is joined to a larger distribution system with other power stations, the supply may be kept up by temporarily overloading the generating equipment in these plants. Because of the different amplitudes of the tidal motion at Brest and at St. Malo, different-size basins would be built at the two stations, an area of 2,000 hectares (4,950 acres) at St. Malo being equivalent in capacity to 6,900 hectares (17,100 acres) at Brest. The average electrical power available in this development is estimated at 70,000 hp., with a maximum of supply of 400,000 hp. and a minimum of 40,000 hp. except for certain periods during at most twenty days of each year, when the supply would be lower. The author points out the high cost of necessary dams and the difficulties of constructing turbines for such low heads.—*Revue Générale d'Electricité*, May 8, 1920.

Traction

The Safety Car.—W. D. BEARCE.—Among the advantages resulting from the introduction of the safety car are: (1) Improvement in service, (2) freedom from accidents, (3) increase in riding habit, (4) lower maintenance cost, (5) reduction in labor cost, and (6) reduction in power consumption. The data in the table illustrate the economies and increased earning possibilities for each car displaced by the lighter safety cars, according to the author. The figures in column A are based on running equal mileage with no increase in cars, those in column B are based on running 40 per cent more mileage with 30 per cent more cars:

Savings Made in	(A) Equal Mileage	(B) 40 Per Cent Increase
Maintenance of equipment, annual saving	$840	$370
Power	1,232	760
Crew wages	3,726	2,280
Total savings	$5,798	$3,410
Increased receipts at 20 per cent	.....	4,222
Increase in net earnings	$5,798	$7,632
Annual percentage of return on cost of safety car, approximately	80	78

The increased service brought about by the use of safety cars is shown by records from eight cities.—*General Electric Review*, July, 1920.

Systems, Installations and Appliances

Testing of Magnetic Compasses.—R. L. SANFORD.—Information gathered at the request of the War Department and the United States Shipping Board. The paper gives a brief discussion of the principal performance characteristics of magnetic compasses together with a description of some of the apparatus which is used at the bureau for testing.—*Scientific Papers No. 382, Bureau of Standards*, June 18, 1920.

Automatic Apparatus for Intermittent Testing.—G. W. VINAL and L. M. RITCHIE.—This apparatus has been devised to meet the needs of the Bureau of Standards in making tests of dry cells and storage batteries, but is applicable to nearly any form of intermittent testing requiring the closing of electrical circuits at regular time intervals. The particular advantages of this type of apparatus for making these tests are: (1) Elimination of rapidly moving parts; (2) accuracy of the time intervals; (3) possibility of making a number of different tests simltaneously with the same apparatus.—*Technical Paper No. 171, Bureau of Standards*, Aug. 14, 1920.

Electrophysics and Magnetism

Loss of Current from Track Circuits.—GIROUSSE.—The present paper forms a continuation of a previous publication which was referred to here some time ago. The author now attacks the very general problem of determining the distribution of equipotential lines around a current-carrying conductor of arbitrary form, which is placed on the surface of and in electrical contact with a semi-infinite body of relatively poorly conducting material. General expressions are obtained by integrating Laplace's equation, but these being rather cumbersome and complicated, they must give place to certain simplified formulas of very satisfactory accuracy. The results of computations according to the new formulas of the potential distribution in several practical cases are demonstrated graphically.—*Revue Générale d'Electricité*, June 26, 1920.

A Rule for Determining the Direction of the Induced Emf.—E. THOVEZ.—The author sets forth a rule for determining the sense of the emf. induced in a conductor in relative motion in a magnetic field. In the case of a conductor in which a current flows the magnetic lines generated by such a current are traced by the corkscrew rule. In the case of a conductor forced through a field by an external force the author gives as the rule that the magnetic lines of the current generated in this conductor are of the same sense as the lines of the magnetic field it meets in its motion. As the lines of the field are deflected, it follows that a force opposite to the driving force acts upon the conductor.—*Science Abstracts, Section B*, July 30, 1920. (Abstracted from *Elettrotecnica*, April 5, 1920.)

Some Applications of Thermionic Valve Rectifiers.—R. L. SMITH-ROSE.—The development of the kenotron rectifier in its application to X-ray tubes and measurement of peak voltages is described. In the second installment the utility of the kenotron rectifier in the production of high-voltage direct current and also the two-electrode valve as a low-voltage rectifier are considered.—*Beama*, June and July, 1920.

Telegraphy, Telephony and Signals

Radio Direction Changes and Variations of Audibility.—CARL KINSLEY and ALBERT SOBEY.—As a result of a large number of systematic measurements on the direction of incoming signals, using loop reception, variations of considerable magnitude in the apparent direction and occurring within short periods of time were found. Their dependence on length and character of wave are studied. There are certain possible theories of transmission proposed to account for the observed phenomena, notably reflection at the atmospheric isothermal layer (6.2 miles, 10 km. high) and the production of rotating fields at the receiving station.—*Proceedings Institute of Radio Engineers*, August, 1920.

Use of Electric Filters for Elimination of Harmonics in Machine Transmitters for Radio.—K. W. WAGNER.—Because of the very troublesome disturbances from the Nauen overtones, the problem of eliminating harmonics in radio transmitters has had much attention in Germany. In the present paper certain experiments are reported, which were carried out in the Siemens & Halske Wernerwerk with high-frequency wave filters. An impure wave was generated by a 9,500-cycle machine and stepped up by two frequency doublers to 38,000 cycles, that is, 7,800 m. wave length. The audibility of the second harmonic, when using beat reception, was about 16.7 per cent of the audibility of the fundamental, while the relative audibility of the third harmonic was about 12.5 per cent. By interposing between the frequency doublers and the antenna an electric filter consisting of two T-sections (inductance in series, capacity in shunt) the audibility of the second harmonic was brought down to a few per cent, while the higher harmonics were almost entirely suppressed. The absolute audibility of the fundamental was diminished only about 5 per cent by the filter.—*Jahrbuch für drahtlose Tel. und Tel.*, May, 1920.

Miscellaneous

New Swedish Water-Power Legislation.—R. GARDING.—Heretofore hydro-electric development of smaller waterfalls has often been delayed for years owing to the difficulty of reaching an agreement in case, for instance, different interests control the two sides of the river. A law therefore has been passed which makes it impossible for one man to hold up the development of a waterfall where he is part owner. If one of the owners, say *A*, offers to the others to enter upon a joint enterprise for the exploitation of the fall, but the other owner, *B*, declines, then *A* has full right to develop all the available water power on his own account, and the law provides what damages he shall pay to *B*. Such damages do not take the form of money, but *A* has to deliver to *B* a certain amount of electric power (in kilowatts) corresponding to *B's* quotum of the available undeveloped power. However, since *A* has to stand all costs, allowance should first be made for first cost, for loss in machinery and for cost of operation, and finally also for the yearly cost of the transmission from the power plant to the place where *B* receives the power. These various cost items are converted into electric energy (kilowatt-years) and subtracted from *B's* part of the total developed number of kilowatts. Mathematical expressions are given showing how the joint owner *B's* net quotum of energy should be computed.—*Teknisk Tidskrift, Elektroteknik*, June 2, 1920.

News in Brief

Summary of Market Conditions and of Recent and Approaching Happenings of Importance to the Industry

APPLICATION for a certificate of public convenience has been filed by the Pacific Gas & Electric Company to develop 358,000 kw. on the Pit River at a cost of $125,000,000.

ENGINEERING COUNCIL has offered its services to the Federal Power Commission to act in an advisory capacity on technical matters and will confer through its waterpower conservation committee with the commission next Friday.

APPLICATIONS for preliminary permits have been made to the Federal Power Commission for developments in southeastern Alaska, on the Withlachoochee River in Florida, on the Des Plaines and Illinois Rivers in Illinois, on the Susquehanna River in Maryland, on the New River in West Virginia and at Priest Rapids on the Columbia River in Washington.

MORE THAN 1,700 employees of the General Electric Company have completed twenty-five years of service with the company, with a combined term of employment of 47,709 years.

SUCCESSFUL TESTS have just been completed by the Navy in electrically piloting vessels into harbor by means of a submerged armored cable.

ARRANGEMENTS have been completed for the annual convention of the Association of Iron and Steel Electrical Engineers, to be held in New York at the Hotel Pennsylvania Sept. 20 to 24.

FROM NOW until Oct. 1, and possibly until November, except on Saturdays and Sundays, electric lighting is barred for advertising purposes, ornamental outdoor lighting and excessive street lighting in northern California because ot power shortage due to low water.

CLASSIFICATION and reindexing of the California Electrical Safety Code and th. National Electrical Code is now under way in California to secure in one place all rules on the same subject in order that inconsistencies may be eliminated and uniform inspection followed throughout the State.

PENNSYLVANIA ELECTRIC ASSOCIATION'S plans for its thirteenth annual convention, at Bedford Springs, Sept. 8-11, have been completed and the program has been announced.

LONGER MATURITIES and higher yields characterized the August electric light and power utility financing, of which a total of $13,620,000, the lowest of any month since February, is reported.

TELEPHONIC AMPLIFICATION of the human voice was used for the first time in Boston, Mass., at an outdoor meeting on Aug. 28, when Gov. Coolidge, Senator Lodge and other speakers addressed the Massachusetts Republican League.

A SLIGHT IMPROVEMENT in collections was noted at the end of last week in New England jobbing circles. Room for much better credit conditions exists, but an optimistic note was sounded by a number of widely separated jobbers as to the outlook.

BETTER LABOR CONDITIONS are here, asserted a number of New England electrical manufacturers, to whom inquiry was directed last week by the ELECTRICAL WORLD.

A VERY FAVORABLE reaction is coming from those societies which were invited to join the Federated American Engineering Societies, from almost all of which replies have now been received.

BECAUSE COAL was accumulating at tidewater shipping points the Interstate Commerce Commission has suspended until Sept. 6 the order granting to New England priority of coal shipments by water.

THE Water Power League of America has arranged for a two-day convention in Washington on Oct. 7 and 8.

A $5,000,000 ISSUE of 7-per cent ten-year gold notes of the Hartford Electric Light Company has just been placed on the market at a price to yield 7⅛ per cent.

WESTERN MEMBERS of the A. I. E. E. are urging that the annual convention be held next year at Salt Lake City in conjunction with the Pacific Coast convention.

ESTABLISHMENT by the Ford Motor Company of an educational department, to be known as the Ford Technical Institute, with university rank, which will grant degrees in mechanical, electrical and chemical engineering, has been announced.

THE Worcester (Mass.) Electric Light Company, it is reported, will increase its coal-excess rate for power on account of the advance in freight rates probably from the present excess of 1½ mills per dollar advance in coal to 2 mills.

STRONG BELIEF in a gradual and natural readjustment of business conditions without financial or economic disorder is expressed by the committee on statistics and standards of the Chamber of Commerce of the United States in its semi-annual review of crop and general business conditions issued on Monday.

THE RIGHT of the Interstate Commerce Commission to issue coal shipment priority orders to the Northwest, New England and to utilities has been raised by certain Ohio cities.

REPRESENTATIVES of the Michigan, Wisconsin, Illinois and Indiana electric associations on Aug. 27 organized the Great Lakes Section of the N. E. L. A.

THE AMERICAN Telephone & Telegraph Company announces that it intends to change as quickly as practicable all its press news service over to printing telegraph.

STOCKHOLDERS of the Philadelphia Electric Company have ratified the proposal to authorize $15,000,000 of 8 per cent cumulative preferred stock, $6,000,000 of which will be offered to stockholders shortly.

FUEL AND CAR shortage has shortened the supply of bare wire, although copper rods are plentiful.

GENERAL ELECTRIC'S business for the first six months of the year was running at an annual rate of $380,000,000 and Westinghouse business during the second quarter of the year at $160,000,000 a year.

SOME IMPROVEMENT is beginning to be noticed in the electrical business as the first of the fall buying appears, although generally summer market conditions continue to prevail.

STOCKS CONTINUE to get better and deliveries are improving, but nowhere are there any complete stocks reported.

PUBLIC UTILITIES of New England, according to a survey made by the Boston News Bureau, have on hand but 28.7 per cent as much coal as they should have at this time.

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

Engineering Council May Advise Federal Power Commission

NEXT Friday the Federal Power Commission will confer with the water conservation committee of Engineering Council, which has tendered its services to the commission to act in an advisory capacity on technical matters. The proffer carries the provision that the committee is to advise on technical matters only, mainly the financial features of the law, such as depletion, amortization of reserves, rental charges and allocation of earnings. Calvert Townley is the chairman of Engineering Council committee. Other members are Charles T. Main, H. Hobart Porter, M. O. Leighton, Allen Hazen, Arthur P. Davis, Arthur E. Morgan and F. W. Scheidenhelm.

Federated Engineering Societies Favorably Received

REPLIES to the letter of invitation to join the Federated American Engineering Societies have been received from nearly every society, according to R. L. Humphrey, chairman of the joint conference committee. While the matter will have to be placed before the membership of each society for action, the replies to the invitation to join show a very favorable reaction.

In addition to the A. I. E. E., A. S. M. E., Detroit Engineering Society and Technical Club of Dallas, which were mentioned in the ELECTRICAL WORLD last week, the Cleveland Engineering Society has joined the federation.

The matter is actively before a number of societies and a decision in most cases is expected prior to the November meeting of the federation. The American Society of Civil Engineers' governing board already has ordered a letter ballot to be taken. The mining engineers have referred the matter to their finance committee, which is expected to take favorable action, and formal acknowledgment is expected at the fall council meeting. The American Society for Testing Materials is about to send out a questionnaire to its membership.

California Power Administrator Curtails Lighting to Save Power

FURTHER tightening of the power use in California, necessitated by the power shortage caused by lack of rainfall last winter, is seen in the following order issued on Aug. 31, 1920, by State Power Administrator H. G. Butler to power companies and city mayors of central and northern California. The order, which is effective immediately and continues in effect until Oct. 1, excepting only Saturdays and Sundays, states that "No electric energy shall be furnished or used for advertisements, notices, announcements or signs designating the location of an office or a place of business or nature of any business; for the external illumination or ornamentation of any building; for lights in the interior of stores, offices or other places of business when such stores are not open for business; for excessive street lighting intended for display or advertising purposes. This order shall not be construed to prohibit furnishing or using electricity for such lights as may be required by law or public safety."

New England Coal Priority Suspended for Few Days

SHORTAGE of vessels at tidewater coal-shipping ports was given by the Interstate Commerce Commission as its reason for issuing an amendment to Service Order No. 11, which suspends from Sept. 2 to Sept. 6 the order giving New England fuel priority. Large accumulations of coal have taken place, especially at Baltimore. The amendment may be extended if the congestion at ports is not relieved.

Manufacturers Attend N.E.L.A. Executive Committee Meeting for First Time

REPORTS of progress were made and budgets presented for approval by the national sections and geographic divisions at the executive committee meeting on Wednesday of the National Electric Light Association. A net gain during the year of 297 Class A members was reported. The publicity program was outlined and approved. Indorsement was given to the action of the American Water Works Association in approving at its recent convention the grounding of secondaries of electric light systems to water piping.

This meeting was the first of a series of three big meetings of the association's executive committee planned for the year. The next will be held in the East in December and the third in Chicago in March.

For the first time manufacturers appeared at an executive committee meeting. Under the new classification adopted at the Pasadena meeting E. W. Rice, General Electric Company; E. M. Herr, Westinghouse Electric & Manufacturing Company, and W. A. Layman, Wagner Electric Manufacturing Company, were appointed members of the committee. Messrs. Rice and Herr were present and Mr. Layman unfortunately was detained en route by transportation delays.

Others who attended the meeting were: President Martin J. Insull, Vice-Presidents M. R. Bump and Frank W. Smith; H. C. Abell, treasurer; W. H. Atkins, Edison Electric Illuminating Company of Boston; T. D. Crocker, president North Central Division; C. R. Hayes, president New England Division; E. W. Lloyd, Commonwealth Edison Company, Chicago; W. C. Lounsbury, president Great Lakes Division; W. R. Kenney, presi-

dent Pennsylvania Electric Association; Walter Neumuller, New York Edison Company; E. A. Phinney, president Rocky Mountain Division; O. H. Simonds, president Middle West Division; M. S. Seelman, chairman Commercial Section; Leon H. Scherck, president Eastern New York Section; M. S. Sloan, vice-chairman Public Relations Section; J. C. Van Duyne, chairman Accounting Section; M. H. Aylesworth, executive manager; S. A. Sewall, acting secretary; A. J. Marshall, committee secretary; Fred W. Herbert, superintendent service department; George F. Oxley, director of publicity; W. J. Canada, electrical engineer; Eugene Vinet, secretary Canadian Electrical Association; and by invitation A. B. Lisle, Narragansett Electric Lighting Company, Providence, R. I.; H. T. Sands, A. B. Tenny Company, Boston, Mass.; R. S. Hale, Edison Electric Illuminating Company of Boston, and R. V. Prather, secretary of the new Great Lakes Division.

Right of I. C. C. to Issue Coal Priorities Questioned

IN A petition for modification of the Interstate Commerce Commission's Service Order No. 10, for priority of coal shipments to the Northwest, Cleveland, Akron and other Ohio cities have raised the question whether the commission has exceeded its authority under the transportation act to issue priority orders.

"If the commission did not have the power to issue Service Order No. 10," said Chairman Clark, "then it follows that it had no power to issue priority orders with respect to supplying coal to public utilities and public institutions. If that is true, then there is nothing to do but to keep hands off and let the coal go where it will."

At the request of the commission briefs will be filed by all those who care to give their view as to the emergency powers of the commission under the car service sections of the transportation act.

Pending the filing of these briefs, an attempt will be made to work out a plan for relieving the cities of Cleveland and Akron and other Ohio cities.

Great Lakes Section of N. E. L. A. Organized

AT A MEETING of representatives from the electric associations of Michigan, Wisconsin, Illinois and Indiana held in Chicago on Aug. 27 the Great Lakes section of the National Electric Light Association was organized. The following officers were elected at that time: President, W. C. Lounsbury, Superior, Wis.; vice-president, Phil Palmer, Lafayette, Ind.; secretary-treasurer, R. V. Prather, Springfield, Ill. Chairman of the various sections were appointed as follows: Public Relations Section, A. C. Marshall, vice-president Detroit Edison Company; Commercial Section, John G. Learned, vice-president Public Service Company of Northern Illinois; Technical Section, George E. Lewis, Detroit Edison Company, Ann Arbor, Mich. The chairman of the Accounting Section has not yet been appointed, but it is expected the selection will be from Indiana.

The general conference of the Great Lakes Section will be made up of three delegates from each member state, each delegation having one vote. Semi-annual meetings of the delegates are to be held in April and July of each year and special meetings may be held upon the call of the president. At the present time it is not the intention to hold an annual convention of the section other than the executive committee meeting. The associations of the four states comprising this geographic section will continue their annual conventions.

Great Western Company Issues Bonds to Complete Caribou Plant

TO COMPLETE its Caribou power project and a new 165,000-volt steel tower transmission line from the Caribou plant to Valona the Great Western Power Company of California has issued $3,500,000 in 8 per cent ten-year bonds. This plant will have an initial installed capacity of 44,000 kw. and the hydraulic development will be sufficient to increase the capacity to 66,000 kw. by the addition of another unit.

It is expected to have the Caribou plant in operation early in the spring of 1921 and the additional capacity of 44,000 kw. will materially relieve the power shortage in San Francisco and the territory served by the Great Western Power Company. H. P. Wilson, vice-president of the company, stated, however, that practically the entire capacity of the new plant was already contracted for and that the installation of the additional unit probably would be made in the near future.

Original estimates on the cost of this project, including the transmission line, were $6,057,430. It is now estimated that the cost will be $10,674,897. Increases in cost of all materials and supplies, increases in wages and difficulty in keeping employees permanently engaged on the construction work were given as reasons for the increased costs.

Further Applications for Water Power Permits

THE Tongass Pulp & Paper Company has applied to the Federal Power Commission for a preliminary permit for the utilization of Fish Creek, Swan Creek, Big Lake, Mirror Lake and Swan Lake, in southeastern Alaska, for power purposes and authority to construct power plants, pulp and paper mills on Carroll inlet. The application is made by M. M. Lyter, attorney, Alaska Building, Seattle, Wash.

The Cove Company of Oscala, Fla., has applied for a preliminary permit to erect a dam and power house on the Withlachoochee River above Stokes Ferry for the purpose of generating hydro-electric power.

The State of Illinois, in the person of Gov. Frank O. Lowden, has applied for license covering power development on the Des Plaines and Illinois Rivers.

W. A. Bromgold of York, Pa., has applied for a preliminary permit to erect a dam on or across the Susquehanna River at or near Cumberland, Md., below the mouth of Yellow Breeches.

The Tri-State Power & Milling Company of West Virginia and the Tri-State Power Company of Virginia have asked for a preliminary permit to erect a dam and a power house for hydro-electric purposes at a point below Anderson Falls of New River, in Summers County, W. Va. The application was filed by O. L. Stearnes of Salem, Va.

The Priest Rapids Irrigation District has made application for a preliminary permit to develop power on the Priest Rapids of the Columbia River. The application was filed by W. J. Kincaid of White Bluffs, Wash.

Geographic Division of Institute Arousing Interest

CONSIDERABLE interest is being taken throughout the country in the division of the membership of the A. I. E. E. into geographic districts, from each of which a vice-president will be elected. This action was decided upon by vote of the membership last spring.

As a result a special committee has been appointed to make recommendations to the directors regarding the number of districts and how they shall be defined. H. H. Barnes is chairman of this committee, which will hold its first meeting on Sept. 9.

Unification of Codes in California

CONSOLIDATION of the California Electrical Safety Code and the National Electrical Code (Fire Code) is now under way by a California committee, with S. J. Lisberger, engineer of the San Francisco district of the Pacific Gas & Electric Company, as chairman. The consolidation will largely be a subject classification and a reindexing so that all similar rules of both codes relating to the same subjects will be congregated in one place under the correct index heading. At the same time inconsistencies will likely be removed and uniform inspection will follow throughout the state. It has also been suggested that the new code recognize the labels of the Underwriters' Laboratories.

The committee of revision is representative of manufacturers, jobbers, contractor-dealers, commercial bodies and labor unions.

Co-operative Movement in British Columbia

FURTHER plans of the British Columbia Electrical Association have been announced by the advisory committee, whose names were printed in the ELECTRICAL WORLD, Aug. 28, 1920, page 448. The foundation of the association will be educational in nature and it will not be the intention to seek directly the sale of more electric appliances or service but to advocate such business methods and co-operation as will result in better business and more general prosperity of the industry. The association will broadly follow the plan of the California Electrical Co-operative Campaign and that to be followed by the Northwest Electric Light & Power Association. The plans of the latter were reported in the ELECTRICAL WORLD, July 17, 1920, page 140.

In detail the British Columbia Association plans to (1) promote the use of proper accounting methods by dealers; (2) assist contractor-dealers to improve their merchandising methods; (3) encourage the use of more advertising by dealers and urge the use of sales helps and advertising issued by manufacturers and jobbers; (4) assist dealers to improve the appearance of their stores and window displays; (5) promote the use of high quality material and workmanship by contractors; (6) encourage contractors to adopt standard practice methods of estimating costs; (7) urge upon contractors and architects the installation of sufficient outlets for the convenient use of all electrical appliances; (8) urge contractor-dealers to make reports to headquarters of appliances sold for the proper guidance of the advisory council; (9) urge non-member contractor-dealers to become members of the Electrical Contractor-Dealer Association of British Columbia; (10) promote better acquaintance and co-operation between central station employees and contractor-dealers and their employees.

385,000-Kw. Pit River Development to Require $125,000,000

THE development of the 385,000 kw. available on Pit River in Shasta County, Cal., 220 miles north of San Francisco, by the Pacific Gas & Electric Company has reached the step where the company has filed an application with the Railroad Commission of California for a certificate of public convenience and necessity.

An ultimate expenditure of $125,000,000, divided equally between power plants and distribution systems, will add 7,000,000 kw.-hr. to the daily capacity of the company's system, which is about double the present capacity of all their plants. The peak load in 1920 is estimated to reach 254,000 kw. and in 1928 388,000 kw., with an output in the latter year of 2,170,000,000 kw.-hr. The present plant capacity of 350,875 kw. will be increased to 590,875 kw. by the addition of 159,000 kw. of hydro-electric plant capacity.

The present plans call for transmission of the Pit River output at 110,000 volts to a point of connection with the 110,000-volt line now in operation between San Francisco and the Drum power station, 144 miles northeast of San Francisco. It is planned that the Pit River power will ultimately be transmitted at 220,000 volts directly to the San Francisco Bay district.

Longer Terms and Higher Yields in August Financing

LONGER maturities and a slightly higher average yield characterize the electric light and power public utility financing for August. The total of $13,620,000, the lowest for any month since February, is made up of bond issues of five companies with no new stock issued. For the first time in three months there is a yield as low as 7 per cent. This is a $1,500,000, twenty-year first mortgage bond issue of the Lawrence Gas Company with a 7 per cent interest rate, which was offered at par. One other issue appears at par offered by the Great Western Power Company of California and bearing 8 per cent. This last issue, however, amounting to $3,500,000 in ten-year bonds, is to be redeemed at 105 and will yield the investor from 10.31 to 8.33, the exact amount to depend on the date of recall. The following table gives the five issues in detail:

Company	Amount of Issue	Period
Lawrence (Mass.) Gas Company	$1,500,000	20-year
Adirondack Power & Light Corporation	5,620,000	30-year
Pacific Power & Light Company	1,000,000	10-year
Southwestern Power & Light Company	2,000,000	5-year
Great Western Power Company of California	3,500,000	10-year
Total	$13,620,000	

Class of Security	Rate of Interest	Per Cent Yield	Offered at
First mortgage bonds	7	7	Par
First and refunding gold bonds	6	7.25	84.50
First lien and general mortgage bonds	8	8.25	98.25
Bond secured gold notes	8	8.50	98
General mortgage convertible bonds	8	10.31 to 8.33 according to date called	Par

Radio Engineers Discuss Progress in Germany and Austria

AT THE first monthly meeting of the Institute of Radio Engineers for the 1920-1921 season, which was held in New York City last Wednesday night, a paper describing types of radio apparatus developed in Germany and Austria during and after the war, read by Dr. A. N. Goldsmith, was a careful translation of the original, "Recent Progress in Radio Communication in Germany and Austria," submitted by Dr. Eugene Nesper of Vienna, Austria. The consensus of the discussion was that, while the types of radio telephone and telegraph sets described showed facilities for wide ranges in adjustment and consummate skill in getting a great amount of apparatus into a small space, this appeared to have been accomplished at some expense in simplicity and reliability.

Dr Goldsmith presided in the absense of the president and the attendance indicated a promising season for the radio engineers.

Europe's Trade More Valuable than Bonds

THE cancellation of the loans our allies obtained from us during the world war would be of great benefit to the electrical industry, is the opinion of Festus J. Wade, president of the Mercantile Trust Company, St. Louis, who was chairman of the committee which represented the American Bankers' Association at the recent meeting of the International Chamber of Commerce in Paris, and who was for many years a director in the North American Company, which controls the St. Louis, Milwaukee and other central-station properties.

In discussing the details of his proposed plan with a representative of the ELECTRICAL WORLD Mr. Wade said:

"It is not with charitable, philanthropic or altruistic motives, but to help keep our factories running and our people employed, that I advocate the cancellation of the $10,000,000,000 that our allies borrowed from us after we entered the world war. It is simply a straight business proposition.

"Manufacturers of electrical and other goods are looking overseas for orders to keep their factories running to capacity, but, owing to the great depreciation of foreign exchange, our European customers cannot buy so much for their money in the United States as they can obtain elsewhere. Furthermore, the depreciated rates of exchange permit European manufacturers to undersell American-made goods in the United States, and the fact that England's exports in July, 1920, were the greatest in her history indicates that serious foreign competition in our home markets is not so far off as some people seem to think.

"Under the circumstances I believe the business of our allies is worth much more to the people of this country than our allies' bonds. We need Europeans as buyers of our products, not as sellers of their goods, so I propose that the United States pay our allies $10,000,000,000 (by cancelling their debts to this country) if they will agree to re-establish the rates of exchange on their currencies at par and hold the exchanges at their normal value for a period of five years.

"It is not intended that the debtor nations should profit by our cancellation of their obligations. It would be done primarily to restore the credit of European countries in the United States to a point where they could buy more in this country with their pound sterling or franc than in any other part of the world. The stronger nations of Europe whose debts we cancel should be required to cancel the debts of smaller and weaker nations to an equal extent. This would aid materially in bringing the finances of the entire world back to a peace basis and would greatly increase the purchasing power of some of the best present and prospective buyers of American products."

Iron and Steel Electrical Engineers Complete Convention Plans

ARRANGEMENTS for the annual convention of the Association of Iron and Steel Electrical Engineers, to be held Sept. 20 to 24 in New York, at the Hotel Pennsylvania, have been completed. The plans call for an extensive program of technical sessions, entertainment and exhibits. The following official program has been announced:

MONDAY, SEPT. 20

Morning—Registration and business session (for members only) with reports of committees and election of officers.

Afternoon—"Practical Education of Steel Mill Electricians," by W. A. Cornwell; "Relation of Standardization in Electrical Equipment to Safety," by Walter Greenwood.

TUESDAY, SEPT. 21

Morning—"Power Transmission for Industrial Plants," by D. M. Petty; "Underground Transmission," by A. L. Freret.

Afternoon—Excursion.

WEDNESDAY, SEPT. 22

Morning—"Some Considerations in the Determination of Auxiliary Drives," by Gordon Fox; report of electrical development committee, E. S. Jefferies, chairman.

Afternoon—"The Reversing Electric Mill Considered from the Standpoint of Tonnage," by K. A. Pauly.

Evening—Annual banquet.

THURSDAY, SEPT. 23

Morning—"Centralized Turbine Generating Stations for Steel Mills," by T. E. Keating; "Current Limit Reactance," by R. H. Keil.

Afternoon—Report of electric furnace committee, E. T. Moore, chairman.

FRIDAY, SEPT. 24

Morning—Standardization committee report, W. T. Snyder, chairman.

Afternoon—Excursion.

Ship Successfully Guided Into Harbor by Radio Detectors

TESTS of a method of guiding ships into port during fogs by means of a cable laid in the channel and energized electrically were successfully carried out at New York harbor last Tuesday under the direction of Commodore R. F. McConnell of the U. S. Navy.

The system consists of a 500-cycle, 500-volt, 2-kw. generator connected to a single-conductor armored cable through a sending key. A current of about 5 amp. is sent through the conductor, returning through an earth connection, and the current is interrupted according to a fixed series of characters in the Morse code. Two detectors, consisting of identical coils of wire, are let down over the sides of the vessel approaching the harbor and a telephone receiver may be connected to either detector, through vacuum tube amplifiers. If one coil is nearer the cable than the other

a louder signal is received from that side and the two give equal reception when the ship is over the cable.

For the purpose of trying out this method of guiding ships a cable was laid from the Ambrose Channel light ship to Fort Lafayette, a dredged channel difficult of navigation. Ships are guided to this point by means of radio compasses or goniometers, located along the coast. Having reached the light ship the guiding cable may be picked up without difficulty. In the tests already referred to a tug, making 10 knots, was piloted over the length of the cable without difficulty, being directed entirely by means of the telephone detectors.

Publicity a Constructive Force When Properly Used

PUBLICITY properly used is a constructive force, J. B. Wooten of New York maintained in his address on "Publicity" at the Michigan Section, National Electric Light Association, at Ottawa Beach, Mich., held on Tuesday to Thursday of last week. He asserted that publicity was a constructive force that has been largely used for destructive purposes. That the utility problem in its relation to publicity must be considered as a problem of the public, otherwise publicity can quickly degenerate into pure propaganda, was pointed out.

The meter maintenance methods of the Consumers' Power Company were outlined by J. C. Langdell. The minimum time interval between alternating-current residence meter tests is believed to be about thirty months, though the possibility of an extension is seen particularly with the newer types of meters, which do not seem to require as close supervision as the older types. Large capacity alternating and direct-current meters require testing from a monthly period in some cases to a maximum period of one year. The adoption of one type of demand meter by a company tends to eliminate operating difficulties because men are not forced to become familiar with different types.

Standardization of materials simplifies and reduces store-room stocks, permits economies by quantity purchasing, provides for interchangeability of parts and effects labor savings by having construction men always familiar with apparatus and materials used, was stated in B. L. Huff's paper on "Standardized Construction—a Money Saver."

Training of the farmer to the use of electrical apparatus as a means of better farm working and living conditions, and the duty of the central station in assuming its part in this training, was urged by Prof. A. R. Sawyer of the Michigan Agricultural College in discussing "Standardization of Electric Farm Equipment."

Expense per consumer has been reduced 14 per cent, errors have practically been eliminated and complete relief from nervous strain for the clerical force has been secured by the substitution of machine billing and ledger posting on the Consumers' Power System, it was stated by Charles H. Hunberger of Grand Rapids. Also it was brought out in the discussion between Mr. Hunberger and J. D. Jacobus of Detroit that by the substitution of higher caliber meter readers and closer supervision a necessary increase of 50 per cent in salaries has increased the cost per consumer only 2.2 per cent.

The necessity of putting statistics in form for ready reference for those central-station executives and employees who must use them was emphasized by H. A. Snow in describing the statistical department of the Detroit Edison Company.

The committee on valuation and rates emphasized the necessity of educational work along these lines. Where utilities have suffered for a long period by reason of rising operating costs, the effect of rising fixed charges due to increased construction and financing costs, it was pointed out, is yet to be felt in its full force. This was also pointed out in the address of President Insull of the national association, who also called to attention the small portion of increased gross receipts that are going to net and the using up of reserve station and system capacity.

The following officers were elected: President, George E. Lewis, Ann Arbor; first vice-president, J. K. Swanson, Jackson; second vice-president, E. Holcomb, Alma; secretary and treasurer, H. Sylvester, Ann Arbor; executive committee, W. M. Lewis, Muskegon; S. B. Tuell, Houghton; H. A. Fee, Adrian; R. E. Keller, Kalamazoo, and B. E. Waltz, Ludington. It was regretted by those in attendance that President W. M. Lewis was unable to be present because of illness.

Pennsylvania Electric Association Meets Sept. 8-11

FOR the thirteenth annual convention of the Pennsylvania Electric Association, state branch of the N. E. L. A., to be held at the Bedford Springs Hotel, Bedford Springs, Pa., on Sept. 8, 9, 10 and 11, the following program has been prepared:

WEDNESDAY, SEPT. 8

Afternoon—Registration.
Evening—Entertainment.

THURSDAY, SEPT. 9

Morning—Address of President W. R. Kenney and routine reports.

Afternoon—Commercial session: Report of rate committee, Henry Harris, chairman; "Power Service," by G. M. Gadsby, West Penn Power Company, Pittsburgh; "Electrical Merchandising," by Thomas W. Berger, Philadelphia Electric Company; "Value of Purchased Power," by Joseph McKinley, Duquesne Light Company, Pittsburgh.

Evening—Entertainment.

FRIDAY, SEPT. 10

Morning—Technical session: Report of engineering committee, Paul Spencer, chairman; "Coal Supply and Distribution," by J. D. A. Morrow, vice-president National Coal Association, Washington, D. C.; Charles J. Russell, Philadelphia Electric Company, will present an abstract of the report on power factor by Messrs. Russell, Gaskill and Currier of the Philadelphia Electric Company; "Coal Storage," by O. P. Hood, chief engineer, Bureau of Mines, Washington, D. C.

Afternoon—Operating session: "Economical Arrangement of Pole-Line Transformers," by George S. Humphrey, West Penn Power Company, Pittsburgh; "Family Spirit in the Organization," by Frank F. Hennaman, Penn Central Light & Power Company, Altoona; and addresses on safety by S. B. Hare, president Railway Claim Agents' Association of the United States, and H. B. Harmer, safety engineer Philadelphia Electric Company.

Evening—Addresses by H. M. Aylesworth, executive manager National Electric Light Association, New York, and Hon. William D. B. Ainey, chairman Public Service Commission of the Commonwealth of Pennsylvania.

SATURDAY, SEPT. 11

Morning—Accounting and executive sessions: Report of accounting committee, H. R. Kern, chairman; an address on "Income and Excess Profits Taxes," and report of public policy committee.

Hartford Company Issues $5,000,000 of Notes for Additions

A NEW issue of $5,000,000 of ten-year 7 per cent gold notes of the Hartford (Conn.) Electric Light Company, due Sept. 1, 1930, has been placed on the market at 95.68, yielding about 7⅜ per cent. Proceeds of these notes will be used to provide additions to the company's power plants and distribution system.

It is interesting to note that this company has no mortgage or other funded debt. The company has outstanding $10,000,000 of capital stock, all of one class, par $100 and selling at $140 per share.

To Use Printing Telegraph for Press Service

AS FAST as it is practicable to do so the American Telephone & Telegraph Company expects to change its press news service over to printing telegraph machines. For several years the company has used the printers for a portion of this service in New York, Boston and Chicago, and much of the company's interoffice communication between New York and Chicago has been carried on by this means.

The printing telegraph has now been developed so that, depending on the class of service, a transmitting speed of twenty to sixty words per minute can be obtained, and by means of synchronized machines sixteen messages, eight in each direction, have been sent over one wire.

At the office of the American Telephone & Telegraph Company it was stated to a representative of the ELECTRICAL WORLD that while the change from the manually operated telegraph to the printers would be gradual there was no doubt but that the printing telegraph would eventually become universal.

Duty of Commissions to See That Utilities Prosper

SPEAKING before the convention of the United States Independent Telephone Association at Winona Lake, Ind., recently, Paul P. Haynes of the Public Service Commission of Indiana declared that there had been entirely too much wailing on the part of utilities and unthinking criticism on the part of the public, and entirely too little constructive effort along educational lines on the part of all. "We all know," Mr. Haynes continued, "that the public has a common interest with the utility, that there is a natural and proper reciprocal relationship between the producer and consumer of the utility product.

"The public interest demands improvements which can only be made by the expenditure of millions upon millions of dollars. These millions of dollars cannot be expended unless the corporations are able to secure them. The corporations cannot secure them unless they are able to show the financial houses from which the money must be secured that the business into which these millions are going is a solvent, healthy and profitable business. The business of utilities cannot be solvent, healthy and profitable unless the public safeguards and protects the utility by adequate rates.

"I may add that it is not only the duty of regulatory bodies to maintain the solvency of these enterprises, but it is their bounden duty to see to it that the utilities they regulate are also healthy and profitable."

Additional Plant Capacity Rushed by San Joaquin Company

ON THE heels of the starting of the new Kerckhoff power house of the San Joaquin Light & Power Corporation announcement is made that ground was broken for a natural-gas-burning steam plant in Kern County, 28 miles from Bakersfield, Cal. The new plant will be rushed to completion to meet the heavy power demand of next summer. All machinery for the first unit, consisting of a battery of tubular boilers, a steam turbine and generator of 17,500 hp., has been ordered and will begin to arrive as soon as the steel and concrete power house is completed, which is scheduled for Dec. 15. It is expected that this new plant will be in operation by next April.

Five units are planned for this plant, which will be one of the largest natural-gas-burning steam plants in the world. About 7,000,000 cu.ft. of gas will be consumed per day for each unit. A transmission line of 110,000 volts with a capacity of 30,000 kw. will connect with the Kerckhoff power line at the Corcoran substation. Another line will connect with the McKittrick substation, from which will be served the West Side oilfield districts of Kern County. The cost of the plant will be $1,750,000 for the first unit and $1,250,000 for each additional unit.

General Electric Has More Than 1,700 Twenty-five-Year Service Employees

MORE than 1,700 employees of the General Electric Company have completed twenty-five years or more of service with that organization. Their combined term of employment totals 47,709 years and their total age is 91,550 years.

At the fourth annual outing of the company's Quarter Century Club, composed of these long-service workers, which was held at Schenectady last week, G. E. Emmons, vice-president in charge of manufacturing, was presented with a gold replica of the Quarter Century Club insignia in recognition of his completion of twenty-five years as manager of the Schenectady works.

Guarding Against Fuel Shortage

COAL being stored for winter months by United Electric Light Company seven miles from its main steam station at State Street, Springfield, Mass. Increased facilities to store 50,000 tons are also being provided at the State Street station.

Electrolytic Zinc Smelter in Norway.—The electrolytic zinc smelter which has been under construction at Glanfjord, Norway, is soon to be opened. It will be the first of its kind in Norway and it is thought that its opening will greatly stimulate the development of new mines and increased production of the old workings. The production of zinc ore in Norway, according to the latest available statistics for the years 1916 and 1917, was respectively 1,121 and 296 short tons.

Electricity on British Canals.—Horses are to be replaced by electricity on an important section of the canal connecting Birmingham, England, with the Severn River. In this way it is expected that the speed of the boats will be doubled. The overhead trolley system will be used. An investigation into the practicability of hauling canalboats by storage batteries is also being made.

Louisville Show Postponed.—The Louisville (Ky.) Electrical Exposition, which was scheduled for Oct. 25 to 30 inclusive, has been indefinitely postponed. The reasons given by the management are the high cost of decorations, labor and advertising matter and the reluctance on the part of manufacturers and jobbers to spend any money in this class of advertising at the present time.

Progress in Electroculture.—Experiments in the Conservatoire des Arts et Metiers at Boulogne-sur-Seine, France, on electroculture by brush discharge are reported to have had encouraging results. From July to October last year the experimenter employed currents of about 20,000 volts, burying the negative pole in the soil and suspending iron wires 6 ft. 8 in. above the ground and about 2 ft. 8 in. apart. The current was applied twice every day for one and a half or two hours. All the plants were fairly advanced when the treatment began. Tobacco plants grew to more than twice the height of those that underwent normal treatment and blossomed in September when the others did not; cabbages improved; potatoes increased by 25 per cent in yield and by 4 per cent in starch, and sugar beets gave 20 per cent more sugar.

Comparison of Norwegian and Swedish Water Powers.—According to a recent comparison, potential water power in Norway amounts to 7,500,000 hp. as compared with 6,000,000 hp. in Sweden; actual development is put at 1,250,000 hp. in Norway and 1,100,000 hp. in Sweden, or 0.5 hp. per capita in the first named country and 0.2 hp. in the second.

Electrical Progress in Argentina.—Judged by the figures given in the annual report of the electrical company of Rosario, Argentina, which has its headquarters in Brussels, Belgium, electrical progress in the Argentine Republic is rapid. The total receipts of the Rosario company for 1919 were 50 per cent greater than those for 1915, and the company had 21,630 customers as against only 1,284 in 1915 and generated 29,812,600 kw.-hr. The great increase of customers is, of course, due to the general wiring of private residences. Flatirons and other domestic electrical appliances also are in very general use.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

Peat as Fuel May Aid Irish Railroad Electrification.—High cost of coal has led to a suggestion, made at a meeting of Irish electrical engineers, that railroad electrification be undertaken in Ireland by means of power derived from peat. This semi-fuel, which exists in great quantities in the Emerald Isle, can, it is estimated, be worked and distilled at a cost that will be fully covered by the value of the solid and liquid products and will in addition yield gas available for power production. One of the advocates of the scheme says that electricity thus generated can be delivered to the railways at 1.4 cents per kilowatt-hour. It would take fifteen years to complete the work of electrification and the cost would be $60,000,000.

Penn State Graduates May Connect with Western Electric Company.—Arrangements have been completed by the faculty of the engineering school of Pennsylvania State College so to arrange certain branches of its curriculum that graduates will be available for employment in the technical and factory departments of the Western Electric Company. Particular attention will be devoted to developing executive possibilities in the students. The Western Electric Company has similar arrangements with several other educational institutions at the present time and in addition maintains a post-graduate course for its own personnel at Columbia University.

German Wireless.—A comprehensive wireless telegraphic system to supplement the ordinary lines and serve as a substitute in case of breakdown is being put into operation by the German post office department. Already transmitting and receiving stations are in operation in most of the large Prussian cities, and Bavaria and Württemberg are to be linked up. A station in Königsberg, East Prussia, permits communication with that district independently of the Polish corridor which separates it from the rest of Germany.

Electrical Development in New Zealand.—The sum of £3,500,000 is named in the budget presented to the New Zealand House of Representatives by the government as that needed for public works, very largely of a hydro-electric character. In addition many municipal electricity supply schemes are under consideration by borough councils, and an era of electrical activity is anticipated.

Electric Service for Conventions.—Electrical service at the Springfield (Mass.) Auditorium is featured by the local Chamber of Commerce in its publicity material welcoming conventions to the city. The auditorium is provided with four-wire, two-phase, 220-volt and single-phase, 110-volt service, besides energy for the operation of motion-picture machines in the convention hall, exhibition hall and "mahogany room." In calling attention to the facilities offered, the chamber points out that all 220-volt, four-wire, two-phase motors used by exhibitors will require a feed line at least 150 ft. in length from the main switchboard, 25 hp. being available on this special line. It is also made known that at the top of every column in the exhibition hall is a 10-amp. plug, installed primarily for lighting purposes and limited to ½ hp. in each case. In the rear and front of the hall are three 50-amp. plugs limited to 4 hp. from each plug. Electric elevator and truck service is also featured in this connection.

Volcanic Electricity.—A recent report on Italy's efforts to use the natural heat emitted from the soil in volcanic regions in lieu of fuel says that a heating plant of 16,000 hp. is operating without interruption at Larderello, in Tuscany, and that electricity generated at this plant is distributed to Florence, Livorno and Grosseto.

Paris Plans to Get Rid of Steam Locomotives.—The electrification of all railway traffic in Paris and its suburbs, which was held up by the war, is now to go forward again, and it is hoped that in two years steam locomotives with their smoke and dirt will be abolished entirely from the metropolitan area.

Additional Rate Increases in New England.—Ten per cent increase in power rates has been declared effective by the Vermont Hydro-Electric Corporation and affiliated properties of Rutland, Vt., resulting from the increased cost of coal to the New England Power Company and interconnected systems. One and one-quarter mills per kilowatt-hour fuel charge above a base of $5 a ton was established on power bills on Sept. 1 by the Cambridge (Mass.) Electric Light Company.

Toledo Rates to Advance.—The Toledo Railways and Light Company has filed with the Public Utilities Commission of Ohio a new schedule of rates showing increases as follows: Lighting service outside Toledo, 9 mills per kilowatt-hour plus 50 cents per month customer charge; low-voltage power service, 5 mills; high-voltage power service, 4 mills; temporary power service, 15 mills; advertising service and flat-rate lighting service, 30 per cent. Ornamental 600-cp. street lamps in Toledo are to cost $70 a year and overhead lighting $60 a lamp.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Utility Cannot Operate at a Loss.—It is not practicable, the Connecticut Public Utilities Commission recently declared, to expect or to compel a utility company to supply service to the public at a continuing, positive and absolute loss.

Agricultural Service.—According to a decision of the California Railroad Commission, flat electric rates for agricultural purposes, the charge being based upon the connected load or the maximum demand of the installation, are not conducive to economy and tend to encourage wasteful use of both water and power.

Free Service Condemned.—The furnishing of free service was declared recently by the Arkansas Corporation Commission to be contrary to the theory of state regulation of public utilities, whether it is done voluntarily or in conformance to a municipal requirement or franchise, since no service can be rendered that does not require some expense and free service to some customers necessitates an additional burden upon others.

Allowances for Past Services.—In granting increased rates to a telephone company the Nebraska State Railway Commission declared that some consideration must be given to past unremunerated services of stockholders and officers where the value of the plant was approximately $30,000 and only $10,000 had been contributed by the stockholders in cash, and where the rates of the company had been uniformly low throughout its history.

Intercompany Rates.—The rates for electricity supplied by one utility to another, the California Railroad Commission has held, should not be based solely on the cost of hydro-electric power produced in that community but on the average cost to the producing company of both steam and hydro-electric power where other communities dependent upon the producing company for power were being served with hydro-electricity generated in that locality prior to any local demand for service.

Pennsylvania Commission on "Going Concern" Value.—In a hearing of complaints made by various municipalities against the Pittsburgh Railways Company, the Public Service Commission of Pennsylvania declared that "'going concern' value was a factor to be dealt with in every valuation case," distinct from good will, which is not to be allowed, and that the "cost of establishing business" or "losses in early years of operation while building up the patronage" is a factor in determining the fair value of a property.

Short-Term Service.—Granting increased rates for electric service to the Iola Light, Power & Manufacturing Company, the Wisconsin Railroad Commission dwelt on the fact that all but three of the company's customers are seasonal uses of its service and should provide sufficient revenue to cover continuous fixed charges which accrue to the plant because of the facilities which the utility maintains the year around. "The short-term consumer," the commission said, "receives service of a special character, and as a consequence his rate should be special and adapted to such service in order not to raise the presumption of discrimination."

Rates for Purchased Energy Should Rise with Cost of That Energy.—In granting an increase in rates to the Electric Light & Power Company of Hightstown, N. J., which had been operating under a reduced schedule filed in 1916, the New Jersey Board of Public Utilities Commissioners said that inasmuch as the reduction of the rates in effect in 1916 was based upon the advantages derived through the purchase of energy by wholesale power contract from the Public Service Electric Company, it would appear only equitable that the increase in cost for this power to the Hightstown company should be reflected in the rates which it is allowed to charge. The company's retail power schedule is the same as the Public Service Electric Company's.

Municipal Franchises and Commission Jurisdiction in Virginia.—Finding that an attempt of a municipality to fix the rates of a telephone company outside of the municipality's boundaries was *ultra vires* and that such rates were subject in their entirety to the jurisdiction of the Virginia Corporation Commission, the commission held that nevertheless those portions of the franchises that covered service within the corporate limits were valid and that as regarded this territory the commission could not fix a rate in excess of the maximum rate specified in the franchise.

"Going Value."—In denying an increase of gas rates to the Niagara Falls Gas & Electric Light Company, request for which had been predicated largely on "going value" covering expenditures through many years, important parts of the plant having become obsolete in the meantime and the legitimate field of the company's business not having been, in the commission's opinion, followed up and occupied, the New York Public Service Commission, Second District, declared: "The theory of respondent's counsel seems to be that a public guaranty is behind a public utility in such wise that the public can be called upon to make good the losses of the utility without regard to their causes or origin. We can find no authority for such a doctrine and are of the opinion that upon the facts shown in this record no 'going value' has been established."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Privilege of Using Streets.—The grant by a municipality of the right to use its streets becomes when accepted, a decision of the New York Supreme Court declares, a contract not a mere privilege or gratuity. (182 N. Y. S. 73.)

Power of Cities in Florida.—Where it is doubtful whether a statute authorizes a municipality to fix rates for a public utility company such doubt must, according to a recent decision of the Florida Supreme Court, in State vs. Railroad Commissioners, be resolved against the authority of the city. Even if authority is given by statute to a municipality to fix rates for a public service corporation operating therein such authority is subject to legislative control. (84 So. 444.)*

Company Liable for Death from Uninsulated Wire Passing Through Tree.—A boy who climbed a tree on his father's premises came into contact with a high-tension transmission wire and was killed. The Supreme Court of Iowa has, in Graves vs. Interstate Power Company, found the company liable in damages, since it was its duty properly to insulate its wires at all points where it might reasonably be anticipated that a person lawfully engaged might be. The right of the boy to climb the tree was sustained. In dwelling upon the duty of the electric company so to construct and maintain its lines as to "prevent" injury and death the trial judge was not acting to the prejudice of the company by throwing upon it the liability of an insurer. (178 N. W. 376.)

Powers of Municipalities in Ohio.—The Supreme Court of Ohio, in City of Toledo vs. Weiler, an action arising in connection with the proposed acquiring by the city of transportation system, found that municipalities of the state are empowered by constitutional provision to acquire any public utility whose service is to be supplied to the inhabitants and may issue bonds for such purpose, a grant of power from the legislature not being a prerequisite, and that the indebtedness which may be thus incurred is subject only to the limitation prescribed by the legislature as to the extent of general tax levies and the aggregate amount of indebtedness that may be incurred for all local purposes. Municipalities must determine for themselves the part of taxing or debt-incurring power to be used for any authorized purpose. (128 N. E. 88.)

*Left-hand numbers refer to the volume, right-hand numbers to the page of the National Reporter System.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

H. W. Eales, chief electrical engineer of the Union Electric Light & Power Company, St. Louis, Mo., has been relieved of the duties of system operation in order that he may devote his entire time to the engineering and construction work of the company. Mr. Eales will immediately begin an investigation of the future power requirements of the St. Louis district, will determine the power-plant capacity needed to supply that service, and will select the most economical site for a new power plant. Before being appointed chief electrical engineer for the company in 1913, Mr. Eales had held the position of assistant superintendent of distribution and assistant chief electrical engineer. Previous to that he was for six years with the General Electric Company, two years at the company's factories and four years as engineer of the St. Louis office. He was graduated from Yale in 1904, is a member of the American Institute of Electrical Engineers and is first vice-president of the Engineers' Club in St. Louis.

H. W. EALES

George F. Williams, who has been general superintendent of the Central Maine Power Company, Augusta, Me., has resigned to become associated with the Androscoggin Electric Company, Lewiston, Me., succeeding Fred E. Gordon, who resigned recently.

C. C. Chesney, general manager of the Pittsfield (Mass.) works of the General Electric Company, has been elected president of the Engineering Society of Western Massachusetts.

Dr. H. J. Van der Bijl, an engineer in the research laboratories of the Western Electric Company of New York City, has been appointed scientific and technical adviser to the bureau of mines and industries of the Union of South Africa. His duties will consist for the main part in establishing a bureau of standards. Dr. Van der Bijl was born at Pretoria, British South Africa, and was graduated from Victoria College. Later he received a doctor's degree from the University of Leipsig. In 1912 he came to the United States and joined the engineering department of the Western Electric Company. In the last few years he has been identified with developments of the vacuum tube and the radio telegraph. Dr. Van der Bijl will sail for England within a few weeks and will report to the British Colonial Offices at London before proceeding to Pretoria.

Karl H. Bronson has become associated with the Square D Company, Detroit, Mich., as director of research engineering and will be actively engaged in the safety campaigns which the Square D Company is undertaking. Mr. Bronson is a graduate of the University of Michigan. Previous to joining the Square D Company he was engaged in sales promotion and advertising work for Dodge Brothers and later for Packard Motor Car Company.

Wiggington E. Creed, who has recently been appointed president of the Pacific Gas and Electric Company of San Francisco, succeeding Frank G. Drum, who has held that position for twelve years, is well known as the attorney-president of the Hooper Lumber Company and for his work in the reorganization of the East Bay Water Company, of which he is also president. Mr. Creed is recognized as one of the most able business men in the West. Besides his interests in public service corporations he has organized some important industrial plants, the most notable of which is the Columbia Steel Company at Pittsburg, Cal. of which he is president. He is a member of the board of directors of the Contra Costa Bank and of the Wells Fargo Nevada National Bank of San Francisco.

W. E. CREED

F. J. Burd, superintendent of the electrical work at the Franklin plant of the Cambria Steel Company at Westmont, Pa., has resigned to enter the sales department of the Cutler-Hammer Manufacturing Company. Mr. Burd entered the Cambria Steel Company in 1918 and a year ago installed two patented automatic-control devices, saving belt and motor. He is a member of the American Iron and Steel Institute and the American Institute of Electrical Engineers.

C. O. Mailloux, president of the International Electrotechnical Commission and past-president of the A. I. E. E., recently sailed for Europe on the Red Star steamship Kroonland. Dr. Mailloux expects to remain abroad for two or three months. He will visit England, France, Belgium and Italy, primarily for business purposes; but he will also confer with M. le Maistre, secretary of the I. E. C., at headquarters and possibly with committees of the I. E. C. in other countries which he will visit.

C. O. MAILLOUX

J. C. Lamb of the commercial department of the Tampa (Fla.) Electric Company has been appointed commercial agent of the Baton Rouge (La.) Electric Company, succeeding W. R. Bell, who has accepted a similar position with the Haverhill (Mass.) Gas Light Company.

E. P. Williams, who had been identified with the Baton Rouge (La.) Electric Company since 1913 and served as assistant treasurer since August, 1916, has resigned to accept a position as assistant comptroller of the Godchaux Sugars, Inc., New Orleans. Mr. Williams is succeeded by W. D. Chalmers, formerly with the Columbus (Ga.) Electric Company. The Columbus Electric Company is under the management of Stone & Webster, Inc.

Eric A. Lof, electrical engineer, power and mining engineering department of the General Electric Company, Schenectady, N. Y., has just returned from a five months' trip in Europe. Mr. Lof visited industrial plants in Sweden, Norway, England, Belgium and France.

Trade and Market Conditions

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies—Notes on Industrial Activities and Business Methods

Standardization of Plugs and Receptacles

ONE of the great difficulties which campaigns for promoting the widespread use of electrical appliances have had to contend with has been the existing confusion caused by there being so many different types of plugs and receptacles on the market. As a step toward rectifying this condition the report of the regulations and standards committee of the Association of Municipal Electrical Utilities of Ontario, which was presented at the association's convention held in Niagara Falls recently, is especially important.

The committee in its report stated that inasmuch as there is no standard practice covering the design of plugs and receptacles for permanent installations and as there is great need of having interchangeable attachments, it would make certain recommendations regarding the standardization of plugs and receptacles. These recommendations were as follows:

1. Receptacles shall have parallel contacts or contacts suitable for both parallel and tandem caps.
2. Plug bases shall have parallel contacts or contacts suitable for both parallel and tandem caps.
3. Caps shall have parallel contacts.
4. Contact dimensions of caps shall be as follows: Outside, 0.560; inside, 0.436; width, 0.250; thickness, 0.062;

The report met with the hearty approval of the delegates and was unanimously carried. It was explained that there are twelve different plugs made by the same number of manufacturers, all of which are now interchangeable. The opinion was generally expressed in the discussion which followed that local managers in the various hydro municipalities should specify these plugs when making their next purchases.

Electrical Manufacturing Industry Progressing in England

NOTWITHSTANDING the difficulties of reorganization and the increased cost of raw materials, according to the *Electrician* the reports of several electrical manufacturing companies of England show excellent results for the past year. These companies report that they have more orders than they can fill and various plans for expansion and extensions are either in progress or projected.

Crompton & Company, controlled by the Armstrong, Whitworth Company, made a net profit of £52,900 for the year ended March 31, against £38,500 for 1918-19. The General Electric Company profits increased from £64,400 to £490,400 in the same period. Plans are under way for expansion of the present plants and the erection of new works for the General Electric Company and its subsidiaries. Provision is being made for doubling the output of the turbine department, and plans are also under way to double the output of lamps. The company has purchased about 100 acres of land and some factories at Wembley for the greater development of the engineering works, the lamp and glass industries and its research laboratories, buildings for which are now being erected. It has acquired considerable interest in a French telephone company, for the purpose of building up a telephone business in France.

The report of the British Thomson-Houston Company is also an interesting document, indicating progress and expansion both at home and abroad. The company contemplates increasing its share capital to £4,000,000, of which £2,000,000 will be ordinary shares of £1 each and £2,000,000 preferred shares of the same denomination. Of the 2,000,000 ordinary shares, 400,000 will replace the 40,000 ten-pound ordinary shares now outstanding and 400,000 will replace the 40,000 ten-pound 7 per cent cumulative preferred shares. New arrangements have been made for extending the territorial and patent rights of the company, while a closer relationship has been established with the French Thomson-Houston Company and an interest has been acquired in the Société d'Electricité et de Mécanique (Thomson-Houston & Carels) of Belgium.

Deliveries of Bare Copper Wire Impeded by Fuel and Car Shortage

ALTHOUGH raw copper is in an easy position and copper rods are plentiful, the supply of bare wire has suffered from unfavorable conditions of manufacture. Chief among the latter are insufficient supplies of fuel and a shortage of cars. Labor has also caused some concern, for though no strikes have been experienced recently, it is reported that a certain indifferent attitude in the past has materially reduced the output of work per man. Some improvement in that respect is now noticed, however. Production is in most cases close to normal, although a few wire manufacturers report a subnormal output. The operation of drawing the wire seems to be causing some delay, consequently the finer sizes of copper wire are much the hardest to obtain.

Demand at present is not exceptionally heavy, and in several quarters it is said to be slackening. Foreign demand is also decidedly off and seems likely to remain so until exchange rates improve. The increase in freight rates granted to steam railroads, however, is expected to result in larger orders on their part, but this buying has not yet begun to materialize. Electric railways are not heavy purchasers of copper wire at present, nor have they been for some time past, because financial relief in the form of rate increases seems to be necessary before appreciable orders can be expected from that quarter.

One of the reasons why bare copper wire has not been as plentiful as might be expected is the very large call which exists for insulated wire. This demand has been so great that much of the bare copper wire which would normally supply the market has been insulated to meet the demand which exists for the covered wire. Consequently, in order to safeguard their needs, some consumers largely overbought and pyramided their orders, with the result of eventually causing demand to slow up, as is now happening. Some few cancellations are reported as the result of this inflation of orders.

Producers seem to be optimistic about the future volume of business, for transportation is easing up slightly and many new projects long held up are expected to go forward. One representative company is buying little copper now, however, as it considers 19 cents too high a price for the raw product and expects this price to drop in view of the present light demand for copper. Other wire makers believe the price of copper, and hence of wire, must advance and not decrease, in view of the estimated increase of a cent per pound in the cost of transportation of copper. Still others hold that no price increase is possible until foreign demand once more makes itself strongly felt here. One of the leading producers is quoting copper wire on a 22½-cent base.

Deliveries are slightly improved. One of the largest buyers of copper wire, who was formerly unable to obtain supplies under six to ten weeks, is now securing deliveries in from ten days to three weeks. This is apparently not a representative case, however, as in general manufacturers are quoting from about six to eight weeks' delivery on large orders.

Business of G. E. and Westinghouse Rapidly Increasing

AS AN indication of the growth of the electrical industry, the current amount of business transacted by General Electric Company and Westinghouse Electric and Manufacturing Company is interesting evidence.

In the first six months of 1920 General Electric Company booked total sales of $190,000,000, or at an annual rate of $380,000,000. The best figure recorded previously was about $230,000,000 of gross sales in 1919. No longer ago than in 1916 the company was transacting business at an annual rate of only $134,000,000. During the first half of this year orders were shipped at a rate of $260,000,000 per year, but an improvement in transportation facilities is evident from the recent increase in billings which were going forward at an annual rate of approximately $275,000,000 the latter half of July. Bookings, however, have slightly dropped off, for in the same period orders were received at a rate which would only amount to $375,000,000 for the year's total. The summer trade slackness is held accountable for this decrease.

The Westinghouse Electric and Manufacturing Company, it is reported, booked orders for the first quarter of its current fiscal year, ended June 30, amounting to approximately $41,000,000, as compared with about $34,000,000 in 1919. This is at an annual rate of more than $160,000,000. During the same period the amount of goods shipped totaled approximately $31,000,000, or almost $7,000,000 ahead of the figures for 1919. However, outstanding orders on the company's books on April 1, 1920, the beginning of the fiscal year, were about $71,000,000, it is learned, while on July 1 the total was approximately $85,000,000, indicating the increasing transportation difficulties. During the month of July the shipping situation eased up sufficiently to allow orders to be shipped at close to an annual rate of $160,000,000. Bookings also increased during that time and at present a yearly rate of about $180,000,000 is said to be a close approximation.

Demand for Electric Ranges Exceeding Production

MANUFACTURERS of electric ranges report a very strong demand for their product. Some producers state that sales are decreasing but even so in most cases the output is so inadequate to meet this call that a large number of unfilled orders have piled up. Even in the metropolitan district, which has long been a most unfertile market for electric ranges, sales are decidedly on the increase, and one manufacturer recently disposed of three carloads in that territory alone. A feature of the demand is the active interest which is being taken in heavy types of ranges for use in hotels, bakeries, etc. Export sales seems rather off, however, the demand from South America, Australia and other foreign countries which have offered good markets heretofore now apparently slackening because of such unfavorable factors as money tightness and an unfavorable exchange rate.

The production of ranges is being materially affected by the car shortage with consequent difficulty in securing raw material. Shipments of steel from the mills are very slow and uncertain, and as a result the present output of ranges is in many cases far below normal capacity. One factory is even so far behind that it will only accept orders for delivery next year. In several other cases manufacturers are applying their output on back orders as fast as the ranges can be made, and only in rare cases have any reserve stocks been accumulated.

Delivery quotations cover quite a range, as in exceptional cases shipments can be made from stock up to about two weeks' time, but in the majority of cases deliveries cannot be made in less than from two to three months. No appreciable trouble with labor has been experienced in this field, and it is also reported that the unit efficiency of workmen is increasing.

Prices have remained steady for some time past, and manufacturers are divided in their opinion as to the probable trend of prices. On one side it is said that higher freight rates and increasing costs of raw material may serve to increase prices, but on the other it is even predicted that cancellations of orders will be made unless lower prices prevail. This viewpoint holds that the upward tenor of costs has reached its maximum level commensurate with the public's ability and willingness to pay. Better merchandising methods and closer attention to missionary work in this field will counteract such a tendency and open up new markets, it is stated.

Metal Market Situation

DULLNESS is still the prevailing feature of the copper market. Conditions now seem to favor the producer, however, as consumers are disturbed by the closing down of some of the mines following the refusal of producers to sell for less than 19 cents. Several inquiries are reported, but actual sales are light. Buyers are seemingly holding off to see how the price breaks, as up to this time producers have been absorbing the increased freight cost of about a cent per pound. Any substantial buying would precipitate a price increase, it is thought. Some few demands for export are being received. The actual number of orders placed is light, but producers are encouraged by the increasing number of inquiries from abroad. Another favorable factor is that interest in copper buying is apparently reawakening in Germany.

Freer offerings of copper are found in the outside market where prices are being shaded from ¼ to ½ cent and even as much as ¾ cent for spot delivery. Second hands are not anxious to sell for later than September or October shipment. Standard copper at London remains rather dull, but prices are surprisingly firm, spot advancing almost £1 within the last week.

The lead market is quiet and presents an easier tone by reason of the arrival of foreign shipments. Demand for zinc is off, the reshipment of American zinc from England at a price of about 8 cents having killed domestic interest. The price of tin seems rather weak as there is little or no demand here. The dullness is making holders uneasy, as even their attempts to offer tin down have met with small response. Little change is evident in the scrap metal market.

NEW YORK METAL MARKET PRICES

	August 24	August 31
Copper	£ s d	£ s d
London, standard spot	94 5 0	95 0 0
	Cents per Pound	Cents per Pound
Prime Lake	18.75	18.50–18.75
Electrolytic	19.00	18.75–19.00
Casting	18.00	18.00
Wire base	22.50–23.00	22.50–23.00
Lead, trust price	9.00	9.00
Antimony	7.00	7.00
Nickel, ingot	43.00	43.00
Sheet zinc, f.o.b. smelter	12.50	12.50
Zinc, spot	8.50	8.30–8.40
Tin	45.75	46.00
Aluminum, 98 to 99 per cent	35.10	35.10

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	15.50 to 16.00	15.50 to 16.00
Brass, heavy	9.25 to 9.50	9.00 to 9.25
Brass, light	7.25 to 7.75	7.25 to 7.75
Lead, heavy	7.25 to 7.50	7.50 to 7.75
Zinc, old scrap	5.25 to 5.50	5.25 to 5.50

THE WEEK
IN TRADE

SOME improvement in trade is noted in New England, where the fall buying movement begins to make itself felt. The electrical business in other districts, however, continues about on its recent summer level. Reports from Southern territory and the Pacific Coast are optimistic nevertheless, and the outlook in the Intermountain section depends upon the harvesting of the crops in sight. The plight of the wool industry in that region has seriously embarrassed business, and dealers at present are retrenching.

Building construction in the Northwest is proceeding at a brisk pace, but has fallen off in New England. In the South and Middle West large construction programs are being held up by high prices and difficulty in obtaining building material. This condition is seriously affecting electrical sales.

Tighter money and slower collections are troubling jobbers in the Middle West and Intermountain section, and in the former district some cancellations are resulting, as they are also in Puget Sound territory, though in the latter section money for credit purposes seems readily available. In the New England states, however, collections are said to be improving.

Stocks, taken on the whole, appear to be in much better shape than some time ago as deliveries continue to improve, but there are no complete stocks in any section. Shortages are felt particularly in rigid conduit and hollow ware.

NEW YORK

In some quarters reports are heard of better business resulting from the first of the anticipated fall buying, but most jobbers state that no increase in their sales volumes has as yet materialized. Trade with these latter distributers is proceeding rather slowly but at about a normal pace for this time of the year. A decided improvement is said to be looked for in business conditions, however, following the week-end holiday which marks the close of the vacation season.

Stocks on the whole are better and continue to build up. Plentiful supplies of weatherproof wire, flush switches, flexible armored conductor and lamps are generally reported. There is still a considerable shortage felt in conduit, outlet boxes and porcelain items, however, and stocks in some other lines of material are spotty.

Business in this territory is still feeling the pinch of the car shortage, though transportation seems to be improving despite pessimistic reports from some distributers, whose viewpoint is perhaps explainable by the fact that deliveries are not improving as rapidly as they would like. Money seems to be tight in the electrical trade here, for though there are jobbers who say their collections are good there are many more who characterize them as slow or even very bad.

Rigid Conduit.—Recent receipts appear to have been but a temporary relief, as stocks are mostly depleted except where an occasional carload arrives. The insistent demand more than absorbs the irregular supply that is available. Prices are more or less arbitrary and cover a wide range, with some jobbers not quoting. Price for ½-in. black ranges from about $87 to $103 per 1,000 ft., and the 1-in. size from about $170 to $189.

Weatherproof Wire.—Stocks are in good shape inasmuch as demand is not very heavy at present and no trouble with shipments is experienced. A representative quotation on No. 6 and No. 8 is 32 cents per pound in carload lots.

Outlet Boxes.—Considerable scarcity is felt in this material, and stocks for the most part are poor. Demand is heavy and some jobbers are sold ahead and will not quote on new orders. Deliveries are extremely irregular. A current discount of 25 per cent is quoted on galvanized boxes and on black boxes, 30 per cent

Washing Machines.—Demand has greatly increased and a heavy volume of sales is reported. The condition of stocks varies, some jobbers being unable to obtain enough machines to supply the demand, while shipments for others are said to be good.

Metal Molding.—There is a medium demand but stocks are spotty. Shipments with some jobbers are poor while others are experiencing no difficult. The three and four wire molding is listed at $160 per 1,000 ft., less about 57 per cent in lots of 5,000 ft.

Flush Switches.—Good stocks are on hand in spite of the fairly heavy demand. The scarcity of porcelain is holding up some items, but in general shipments are coming through nicely.

Flexible Armored Conductor.—Demand is decidedly less and with fairly regular shipments considerable stocks are accumulating. Prices are being cut, the current quotation for No. 14, two-wire, ranging from $98 to $104 per 1,000 ft., and in a few cases slightly above that figure.

Non-Metallic Flexible Conduit.—A normal demand is reported which in some cases is even ahead of the supply, as one leading jobber is sold ahead and will accept no new orders. Shipments are only fair and stocks are spotty. The price for ⅜-in. is quoted at about $33, and for the ½-in. size, $35 per 1,000 ft.

Lamps.—Demand is fairly good but the expected fall increase in sales has not as yet begun to make itself felt, and stocks are still building up. Some jobbers are complaining of slow deliveries in their efforts to obtain supplies, especially in type "C" lamps.

CHICAGO

Business is subnormal in this district even for the summer months and watchful waiting is the order of the day. Building construction estimated at $150,000,000 is now being held up in Chicago by prohibitive costs of material, and a continuation of the present curtailment of building will mean that construction will practically come to a standstill within sixty days. Cancellations and slow collections are the principal troubles experienced by electrical jobbers. Stocks are in such shape that almost any standard line can be obtained in the territory but no jobber has a complete stock. Jobbers and manufacturers are both busy filling back orders, but comparatively little new business is being booked. For this reason there is small interest in deliveries that jobbers or manufacturers can make at present, even though orders are now being filled in much better time. Dealers are working hard to move the stocks that are being accumulated but without much success as retrenchment is the present policy of the public.

Dry Cells.—Stocks are in fair condition and demand is being well maintained. The price for standard Red Seal batteries, f.o.b. factory, is $32 per 100.

Insulating Material.—Stocks of mica, varnished fiber, etc., are not in very good shape, but better deliveries are now promised by the factories because of the falling off in the demand from the automobile industry.

Electric Road Trucks.—Factories are busy filling back orders. The increasing cost of gasoline is responsible for many inquiries which will result in business later, it is expected.

Marine Fittings.—The demand is steady though the volume of business has dropped off considerably since the war.

Schedule Material.—Demand has fallen off and factory deliveries are improving. Some attachment plugs can even be obtained from stock.

Rigid Conduit.—Jobbers' stocks have been almost depleted by the rush to get shipments before the freight increase became effective.

Fans.—Factories are nearly all cleaned out. Many retailers will carry over fans through the winter but by far the major portion of the unsold fan production is in jobbers' stocks. The smaller sized fans have been the best sellers this season and it is the larger ones, especially 16-in. which have been left unsold. Practically no industrial demand has been felt.

Hollow Ware.—There have not been as many cancellations as in some other lines, and manufacturers report that it will take some months for them to catch up with back orders at the rate new business is coming in.

Irons.—This is a line for which orders are still being received by manufacturers. However, factories are catching up, and deliveries are improving.

Lamps.—Manufacturers have built up good stocks of practically all standard lamps. There is still some shortage of 10-watt lamps and of series lamps for street lighting. The demand for lamps of 200 watts and above is increasing more rapidly than for lamps of the smaller sizes.

BOSTON

Electrical supplies and material are moving well as the fall buying begins to take shape. Collections have a slightly better tone. Stocks are improving in most lines, barring small motors, rigid conduit and porcelain. It seems doubtful if stocks will run to excess during the coming winter, judging by present accumulations and the conservative ordering now evident. Labor is quiet this week and indications of a widespread improvement in its attitude in the electrical industry are beginning to appear. Prices are still firm, except for occasional cuts to move products at once. Brass wire advanced ½ cent per pound and brazed tubes 1 cent on Aug. 21. Building and engineering contracts in New England for the week ended Aug. 26, 1920, total $5,171,000, compared with $5,097,000 for the same week last year. A gradual recession in the weekly volume of new building construction can be seen. Business in the leather industry is very dull, and the textile manufacturers have not yet resumed production in numerous closed mills, although it is expected that conditions will improve this month. Reduced buying of electrical supplies is an outcome of textile manufacturing curtailment.

Insulators.—Jobbers report 2,300 and 4,600-volt insulators very scarce, especially in lower Connecticut. Neither glass nor porcelain can be had in the desired quantities.

Sockets.—Manufacturers are hard pressed to obtain porcelain, and the effect of recent labor troubles in the brass industry has not yet been overcome. Jobbers' stocks, however, are in good shape, and a healthy demand exists. Pulls quote 50 cents net, keys 28 cents and keyless 26 cents in case lots.

Rigid Conduit.—Stocks are very spotty and deliveries highly unsatisfactory. Current requirements are being met by "pick-up" orders, and long overdue carload shipments hardly arrive before they are sold. Last week a leading jobber had fair supplies of 1-in. and smaller pipe, but could not obtain 2-in. pipe, though it is the small sizes that are generally scarce in New England shipments.

Motors.—Demand holds up strongly for small sizes. One large jobbing house normally carrying a stock of 600 motors had only twenty on hand at the beginning of the week. Immediate orders are being filled only after extensive canvassing of the market.

Wire.—Rubber-covered No. 14 is selling at $11.75 per 1,000 ft. in 5,000-ft. lots. Weatherproof base is 27¼ cents, bare base, 22¾ cents. On weatherproof deliveries of six months are being quoted on quantity orders at the factories. Bare wire can be had in four to eight weeks according to size and quantity. Flat wire is quoted on seventeen weeks' delivery by a leading manufacturer.

Non-Metallic Flexible Conduit.—Good stocks are in hand, and buying is steady with even prices. There is no change from last week in quotations.

Heating Appliances.—Irons are plentiful in this territory, and demand is brisk. Hollow ware is scarce, and the outlook for the supply of toasters, percolaters and small grills is none too good for the holidays. It is reported that one prominent manufacturer of hollow ware is refusing orders for delivery prior to Jan. 1. Buying of reflector-type heaters has begun for fall business. Dealers admit that present prices are an obstacle to buying, but the growth of domestic and industrial heating applications of electricity is so great that a large volume of business is being handled notwithstanding current price levels.

Fans.—Jobbers who ordered large consignments for this year will probably carry over larger stocks than they prefer. Neither wholesale nor retail stocks are exhausted. Some jobbers would be glad to sell their present stocks close to cost in order to get rid of them, and price cuts within the next fortnight would not be surprising.

Lamps.—Careful buying is encouraged by distributers to avoid a shortage in the winter. The 150, 100 and 75-watt gas-filled lamps are hardest to get just now. Sign lamps are in good supply for fall trade. Dullness in textile and leather manufacturing plants is expected to curtail the demand from these quarters. Prices are steady.

ATLANTA

The dull summer season, combined with the recent spell of inclement weather, has served to slow up all lines of business throughout the section. Apparently, however, the bad weather is over, and this together with the approaching fall season gives hope of the resumption of demand on a par with earlier this summer, though the increasing difficulty in obtaining building material is causing serious delays in construction already under way. This, of course, is holding up electrical construction and somewhat easing the shortage in electrical supplies. The coal situation has caused a number of the large cement plants to curtail production, and in some instances to shut down altogether. This condition, unless shortly relieved, will cause serious difficulties in this section.

Agricultural conditions throughout the section on the whole are quite satisfactory, though sufficient time has not elapsed since the recent rainy weather to determine the extent of damage done the cotton crop, which is already about two weeks late. While the corn crop in Georgia is stated to be below the average, the shortage will be largely offset by the tobacco and sweet potato crops. Conditions in Florida are excellent, with the estimated citrus crop running about 5,000,000 boxes above the 1919-1920 season.

Bank deposits are approximately 20 per cent above those of last year. Bank clearings for the section as a whole show a fair increase, while the local clearings are practically the same as for last year.

Distributing Transformers.—Local stocks except in very small sizes are completely exhausted, and great difficulty is experienced in meeting a very insistent demand. Central stations are being compelled to hold up connections of large power consumers because of the inability to obtain transformer equipment. Manufacturers say little relief from the present situation is to be expected unless the demand eases off considerably.

Portable Lamps.—In anticipation of a heavy holiday demand jobbers are placing large orders for all types. Silk shades have been stocked more heavily than last year. Orders from retailers have not yet begun to materialize. No further price reduction in silk shades is expected.

Holiday Toys.—Jobbers have accumulated unusually heavy stocks and report that buying by the retail trade for the holiday season is already under way. A record business in this line is expected and retailers are being urged to place orders far in advance.

Outlet and Switch Boxes.—Recent receipts of large shipments have served to materially ease the situation and boxes in assorted sizes and types are reported on hand in fair quantities. A brisk demand is to be noted in the face of shipments quoted at from three to four weeks.

Non-Metallic Flexible Conduit.—Large receipts have served to fill all back orders and several jobbers report the accumulation of quite sizeable stocks. Demand is reported as holding up quite well with a price on lots of 1,000 to 2,500 ft., ⅜-in. of $4.62; ½-in., $4.24, per 100 ft.

Flexible Armored Conductor.—The shortage continues acute, as with most galvanized products. Shipments are entirely insufficient to meet the demand, and such quantities as are received are forwarded on an allotment basis. Price, 2-wire, No. 14, lots of from 1,000 to 2,500 ft., $11.60 per 100 ft.

SAN FRANCISCO

Although construction work has decreased and appliances, considering the territory as a whole, are slower, yet the sales of real estate, especially in the home tracts, and the decreasing number of such sales as a speculation, are proof of heavy electrical work to be undertaken during the remainder of this and next year. In fact, prophets of what is termed the "big crash" have postponed its arrival beyond next Christmas because of unmistakable signs of a banner holiday season, and there is doubt that it will materialize at all. The past three winters have been dry, but weather experts are foretelling a much needed wet season. A note of conservatism is apparent, which will have a beneficial effect on firms who have been rather spoiled by easily acquired business.

With the closing of the successful electrical home in Sacramento, another has been opened in Oakland and is attracting more interest than the first. More emphasis is being placed upon the outlet demonstration, and architects report many interesting inquiries.

Vacuum Cleaners.—Good stocks are reported and sales campaigns on special types have made these the best-selling household device at the present time. Better shipments of attachments are reported, but orders are still far in excess of supply.

Motors.—Deliveries are better on all motors except the single-phase type. Deliveries on 10-hp. and larger sizes are especially good.

Schedule Material.—Pull-chain sockets have been in high demand during the past week. There are better shipments from the factory. Lock sockets, urgently needed and almost impossible to obtain during the spring, are now much slower.

Conduit.—Deliveries are again bad. Several jobbers report that despite empty racks they have not even a car en route.

Boxes.—Deliveries are very slow, and the shortest stocks are on the best sellers, such as the 4-in. round and octagonal.

Water Heaters.—Nearly all firms say that these are selling better, although many of the orders being shipped now were taken during the early spring. It is hoped that present and future deliveries will cope with the demand.

Heating Appliances.—There is quite a call for medium and heavy soldering irons. Percolators are once again to be found on the shelves after a dearth that has endured since last Christmas.

Lamps.—The Coast to date has not experienced any shortage. White Mazdas are selling much slower than formerly.

SEATTLE—PORTLAND

Jobbers in the Puget Sound district report a small volume of business during the past week, although the movement of heating appliances, which has begun earlier than usual this year, will in a measure offset dullness in other lines. Sales of schedule material and household devices such as ranges and washing machines are dropping off, while buying of the larger-sized motors and heavy power apparatus is practically at a standstill. Retail sales of vacuum cleaners, electric tableware, ornamental glassware and socket heating appliances are reported satisfactory. Spokane jobbers report trade is holding up well, and seasonable weather has benefited retail business. Washing machines, cleaners, table ware, etc., are moving especially satisfactorily. Stocks are much improved and collections throughout the entire inland empire are good.

Retailers in the Portland district are finding business fairly good, some stores reporting that the volume of sales is just about holding its own with a year ago, while others say that there is an appreciable improvement. There seems to be a falling off in purchases of high-priced appliances such as ranges and washing machines, with a noticeable increase in the movement of smaller appliances. Contractors report that enough business is booked to carry them through for at least the next sixty days, by which time they will have passed the ordinarily dull season. More men are being employed in electrical installation work than last month. Collections are slow but contractors in good standing do not find serious difficulty in getting credit extended when they need it. A résumé of building activities as given by the city Building Department shows a total both in number and value of new buildings substantially greater than for the corresponding period of 1919. Increased freight rates and consequent cancellation of orders in great volume are the big problems now confronting the lumber industry. Plans are completed for the new Cedar Falls hydro-electric plant of Seattle's municipal power system, which is capable of developing 20,000 additional horsepower and will cost $1,000,000.

Switch Boxes.—Demand has been falling off and at present is at a minimum. Stocks are in good condition and shipments are fairly easy to obtain.

Porcelain Sockets, Receptacles, Etc.—Stocks are sufficient to care for the good demand existing, though the call is growing lighter from week to week.

Lamps.—It is believed that the fall season has started. Trade is picking up and from all indications sales will compare favorably with last year. Stocks are in fine condition and shipments are easy. Prices are tending upward.

Lead-Covered Wire.—Demand is only fair with good stocks the rule. Shipments are good but prices are expected to show further increases.

SALT LAKE CITY—DENVER

Tighter money is hindering irrigation construction and electrical power projects in the West. As a result labor is plentiful in all lines of building. No new projects are being launched, as present work is confined to finishing jobs already begun.

The adoption of the American plan of labor has caused a considerable influx of non-union laborers, but on the other hand, many union men have gone to parts of the country where the union plan prevails, but they have not left in sufficient numbers to offset the increase.

The strike of the International Brotherhood of Electrical Workers is over in Salt Lake City, and union labor in other cities has also compromised its disputes. It is conceded, however, that the settlement is only temporary and that the adoption of the American plan was made imperative on the union men by the pinch of being long unemployed. They virtually yielded under protest and will probably renew the fight when an opportune time is at hand.

The demoralized wool market continues to affect the intermountain region adversely. Millions of dollars that would normally be in circulation are this year not available. The condition of the metal market is another serious setback to the mountain states.

The recovery of business to its normal state hinges on the marketing of crops, particularly of sugar beets, though it is believed that the wheat crop alone will not alleviate the situation materially, since banks are demanding that farmers take up their notes.

Jobbers expect little if any improvement in trade during September. They are getting in ample stocks and doing everything possible to awaken dealers to the need of being prepared, but the latter are prone not to stock until they are confronted with an actual demand for their wares.

Washing Machines.—These are moving slowly. Buying is stimulated by some dealers by liberal time payment terms. Factories are caught up with back orders and are anxious in many cases to unload on jobbers. As a result there is an overstock in some quarters.

Heating Appliances.—Demand is rated fairly good considering the general recession in trade. Dealers report that buyers are not averse to paying the prevailing high prices, and jobbers' stocks are pretty well filled up. There is some scarcity of hollowware, however.

NEW APPARATUS & APPLIANCES

A Record of Latest Developments
and Improvements in Manufacturers' Products
Used in the Electrical Field

Candy Maker's Chocolate Heater

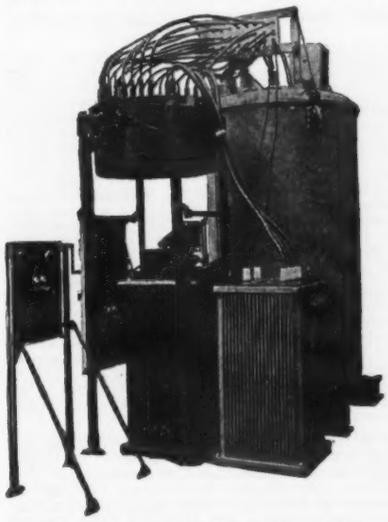
The Cutler-Hammer Manufacturing Company, Milwaukee, is introducing an improved electric heater for melting chocolate used in making candy. As this work requires a constant definite

KEEPS SIX QUARTS OF CHOCOLATE HOT

temperature, a low heat is provided which exactly maintains the required temperature. A medium and a high heat under control of a snap switch are used when new supplies of chocolate are introduced. The three heats provided are 55 watts, 110 watts and 220 watts. The weight boxed is 17 lb., and the capacity is 6 qt. or 15 lb.

Regulator for Electric Furnace Voltage Control

For controlling the energy input for large electric furnaces the Westinghouse Electric & Manfacturing Company, East Pittsburgh, Pa., is manu-

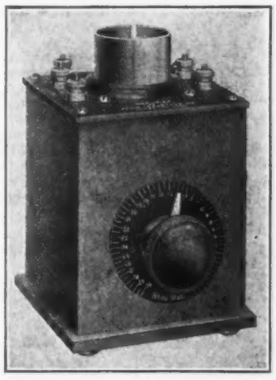


FURNACE REGULATOR WITH TRANSFORMER AND CONTROL PANEL

facturing a step induction regulator to give a uniform voltage over a wide range. The regulator consists of a furnace transformer, an induction regulator, switches and push-button control. This apparatus utilizes the principle of varying the high-voltage tap on the transformer for controlling the energy input to the furnace. The function of the induction regulator is to vary the voltage between taps. After the voltage of the adjacent tap is reached, the selector and transfer switches automatically transfer the inductor regulator so that it will function between the next two taps.

Very Small Amplifiers and Detectors

A single-stage amplifier and a detector developed by the Acme Apparatus Company, 27 Windsor Street, Cambridge, Mass., each have over-all dimensions approximately only 3¼ x 3¼ x 5½ in. The amplifier contains all the essential parts except the vacuum tube and batteries. An Acme



VERY SMALL RADIO APPARATUS

amplifying transformer is included. The binding posts on these pieces of apparatus are so arranged that it is an easy matter to make a detector and two-stage amplifier with separate filament control and the same batteries.

Notes on Recent Appliances

Radio Transmitting Key

The Eastern Precision Electrical Instrument Company, Rockville Center, N. Y., has placed on the market a navy-type, heavy-duty radio transmitting key.

Regenerative Receiver

A. H. Grebe & Company, Richmond Hill, N. Y., have placed on the market a short-wave regenerative receiver, type CR-3.

Color Screen for Window Lighting

A means of producing colored light in show windows has been developed by the National X-Ray Reflector Company, 235 West Jackson Boulevard, Chicago. This "Color-Ray" consists of a metal frame which supports a slide of colored gelatine held in place by fine steel meshes. The color can be changed readily or the slides may be left out altogether. The frame is fastened to

COLORED SCREEN ATTACHABLE TO REFLECTOR

an X-Ray reflector by an asbestos cord harness without disturbing either the reflector or the lamp. Colored gelatine, it is claimed, will not fade under the heat of the Mazda "C" lamp.

Lamp Has Two Filaments

When one filament has burned out the second filament may be put in service in the "Dualite" lamp, developed by the Whitelite Electric Company, 368 Broome Street, New York, N. Y. The lower filament is connected to light when a cap is screwed in at the base of the lamp. When this filament has

TOP FILAMENT USED AFTER BOTTOM BURNS OUT

burned out the other filament is put into the circuit by unscrewing the cap. It is claimed that the gas in the bulb makes discoloration improbable.

MANUFACTURERS' ACTIVITIES

Record of Changes Affecting Sales and Distribution Together with Trade Personals and Notes on Foreign Trade, Jobbers' News and New Trade Literature

THE NATIONAL LAMP WORKS, of the General Electric Company, Nela Park, Cleveland, Ohio, is planning to erect two factories in Indianapolis, Ind., for the manufacture of incandescent and automobile lamps. The proposed plants will have a capacity of 160,000,000 lamps a year and will cost about $2,000,000.

A. W. DODGE, formerly assistant production manager in the fractional-horsepower-motor department, Lynn works of the General Electric Company, has been appointed production manager of the D & W Fuse works, General Electric Company, Providence, R. I.

THE SUNLITE PRODUCTS COMPANY, Plymouth Building, Minneapolis, Minn., has made arrangements for the distribution of the Peerlite lighting fixtures, manufactured by the Peerless Light Company, Chicago, in the states of Minnesota, Iowa, North and South Dakota.

THE WESTERN RED CEDAR ASSOCIATION held its fifteenth annual meeting at Spokane, Wash., on July 30. Nine companies were represented, including the E. T. Chapin Company, Lindsley Brothers Company, Metropolitan Cedar Company, National Pole Company, Northern Cedar Company, Sandpoint Lumber & Pole Company, Searl-Waterman Company, Valentine Clark Company and Western Lumber & Pole Company. The officers elected for the following year are: Morton Macartney, president; E. A. Lindsley, vice-president, and G. A. Clark, secretary and treasurer.

WESTINGHOUSE AWARDS ENGINEERING SCHOLARSHIPS.—The war memorial scholarship committee of the Westinghouse Electric & Manufacturing Company has announced as winners of the four scholarships for the coming year, 1920-21, Alva C. Corroa, small-motors drafting department; Henry Gardiner Symonds, son of N. G. Symonds, manager industrial sales division, Chicago office; J. Dale Seabert, transformer engineering department, and Herbert Hillman, son of William A. Hillman, who has been a machinist in the works of N. D. Nuttall for twenty-seven years. The four awards for the coming year are in addition to the four scholarships awarded last year, all of which have been continued for the coming year. Four new scholarships will be awarded, and eventually the company will be maintaining sixteen scholarships in the leading schools of the United States.

THE NATIONAL CONDUIT COMPANY, Hastings-on-Hudson, N. Y., shows from net sales approaching $7,000,000 for six months ended June 30, 1920, a profit of $499,183, whereas a loss of $516,300 was incurred in the previous year on net sales of $4,760,000. Through writing off $129,396 to depreciation and organization expenses, the books showed a loss for the half year to June 30, 1920, of $80,213, as against a loss of $643,000 in the corresponding six months of 1919.

THE VOSS BROTHERS MANUFACTURING COMPANY, Davenport, Iowa, has nearly completed a new factory, which will be devoted largely to the manufacture of a new type of motor-driven washing machine. The company also contemplates the construction of a foundry, on which work will soon begin.

THE ACME DIE-CASTING CORPORATION, Bush Terminal, Brooklyn, N. Y., has recently opened a branch office in the machinery exhibition sales department of the Philadelphia Bourse. This office is in charge of Edward McK. Hunt, and it will handle the company's rapidly growing business in New Jersey, eastern Pennsylvania, Maryland, Delaware and the District of Columbia.

RECAPITALIZATION OF MANHATTAN ELECTRICAL SUPPLY COMPANY.—Stockholders of the Manhattan Electrical Supply Company, 17 Park Place New York City, have approved a plan for recapitallzation which provides for an authorized issue of 250,000 shares of capital stock without par value, of which 70,000 shares will be exchanged for the present preferred and common, while the balance will be sold to provide additional working capital for the company.

THE MONO CORPORATION OF AMERICA announces the removal of its main office from Buffalo, N. Y., to 25 West Broadway, New York City, where a complete line of its automatic continuously recording gas-analyzing instruments for CO_2, CO, O_2, SO_2, H_2, N_2 CH_4, etc., will be displayed.

THE STROMBERG ELECTRIC COMPANY, 209 West Jackson Boulevard, Chicago, manufacturers of time-recording systems, announces that it has opened an office at 803 Lexington Building, Baltimore, Md., with C. F. Ressiguie in charge.

THE DRENDELL ELECTRICAL & MANUFACTURING COMPANY, San Francisco, Cal., manufacturer of switchboards, panelboards and safety products, has recently made several changes in its organization. A. E. Drendell, former president of the company, has sold his interest in it to L. Siebert and J. Gensler, who will continue the business at a new plant at 1345-1353 Howard Street, San Francisco. Mr. Gensler, who was formerly manager of the Electrical Construction Company, Oakland, is president of the Drendell company, and Mr. Siebert, who has been associated with the company for the past fourteen years, is secretary and treasurer.

LANDERS, FRARY & CLARK, New Britain, Conn., are planning to erect a three-story addition, 60 ft. x 210 ft., on Ellis Street, to cost about $115,000.

THE BURKE ELECTRIC COMPANY, Erie, Pa., announces the appointment of L. L. Myers as general Western sales manager, with headquarters in the Illuminating Building, Cleveland, Ohio, where he has been for several years as sales representative of the Burke Electric Company for the Cleveland territory. L. B. Ritchie has been appointed Eastern sales manager, with headquarters at 30 Church Street, New York City, where has for some time been sales representative of the company for the New York district. The direction of the Eastern and Western sales management was formerly centered at Erie in charge of H. A. Brown, who has resigned.

THE ILLINOIS ELECTRIC PORCELAIN COMPANY, Macomb, Ill., has nearly completed extensions to its plant, which will increase its output 30 per cent. The additions consist of a porcelain testing department, 72 ft. x 84 ft.; a new sagger department, 50 ft. x 96 ft.; an addition to kiln room, 70 ft. x 72 ft., and an addition to warehouse, 76 ft. x 175 ft., all being one-story buildings.

THE ROLLER-SMITH COMPANY, 233 Broadway, New York City, announces that C. H. Mohr has been added to the sales force of its Baltimore representative, the Perkins-LeNoir Company, 113 East Franklin Street. He will devote his attention to the various lines of electrical apparatus handled by the Perkins-LeNoir Company and will specialize in the Roller-Smith products, comprising electrical instruments, meters and circuit breakers. Mr. Mohr has been connected in the past with the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., and with the Standard Electric Elevator Company, Baltimore.

W. WOODWARD WILLIAMS, formerly vice-president of the Reading (Pa.) Iron Company, has been appointed assistant to the president of the Pittsburgh Gage & Supply Company, manufacturer of the "Gainaday" electric washing machines, ironing machines and vacuum cleaners, etc. Mr. Williams was graduated from Harvard in 1905, after which he spent six years in the mills of the Carnegie Steel Company. His first selling experience was with the Bourne-Fuller Comapny, Cleveland, Ohio, and in January, 1914, he became general sales manager of the company. He left the latter company to become general manager of the Reading Iron Company and later was elected vice-president and in charge of sales and operations.

THE NATIONAL INDUSTRIAL CONFERENCE BOARD announces the removal of its headquarters from Boston, Mass., to 10 East Thirty-ninth Street, New York City, effective Aug. 23.

THE JOHN C. DOLPH COMPANY, 168 Emmett Street, Newark, N. J., manufacturer of insulating varnishes and compounds, announces the appointment of Baker-Joslyn, 183 First Street, San Francisco, Cal., with branches in Los Angeles, and Seattle, Wash., as general sales agents and distributers of its products on the Pacific Coast. L. L. Fleig, 212 West Austin Street, Chicago, Ill., has been appointed general Middle Western sales agent, covering Chicago, Cleveland, Detroit, St. Louis and territory comprising the Middle Western States. The Edgar O. Oeters Company, the Bourse, Philadelphia, will represent the company in Philadelphia and contiguous territory.

KLIEGL BROTHERS, 240 West Fiftieth Street, New York City, manufacturers of electric lighting devices, have acquired property on West Fiftieth Street, between Eighth and Ninth Avenues, on which it will erect a new four-story plant. Upon completion of the building the present works of the company, in the same block, will be removed to the new location.

THE DIFFERENTIAL STEEL CAR COMPANY, Findlay, Ohio, recently incorporated with a capital stock of $300,000, has purchased the government munition plant at Findlay, Ohio, formerly occupied by the Grant Motor Car Company. The company proposes to manufacture electric dump cars and other equipment.

Supply Jobbers' Notes

THE NORTHWESTERN ELECTRIC EQUIPMENT COMPANY, 35 Vestry Street, New York City, has filed notice of increase in capital stock from $10,000 to $200,000.

THE CHESAPEAKE ELECTRIC COMPANY, 205 North Calvert Street, Baltimore, Md., will move to 38 South Calvert Street on Sept. 1. T. H. Hardesty, Jr., is purchasing agent.

THE SOUTHERN ELECTRICAL SUPPLY COMPANY, Atlanta, Ga., will shortly move into its new warehouse on Whitehall Street, Atlanta. The new quarters will give it approximately 30,000 sq.ft. of floor space.

P. R. BOOLE, formerly general sales manager of the Electric Appliance Company, Chicago, Ill., has been appointed vice-president and general manager of the G. Q. Electric Company, 25 Erie Street, Milwaukee, Wis., electrical jobbers. Mr. Boole will have charge of sales.

Foreign Trade Notes

DEVELOPMENT OF HYDRO-ELECTRIC PROJECTS IN NEW ZEALAND.—In the budget recently presented to the House of Representatives in New Zealand funds were provided for the development of various industries and trades of the State. An additional sum of £3,500,000 was appropriated for the development of hydro-electric projects and other public works. There are also many municipal electric supply schemes under consideration. There is a good demand for electrical machinery transmission-line material, motors, lamps and other electrical apparatus.

THE HURLEY MACHINE COMPANY, Chicago, Ill., has recently commenced manufacturing its dishwasher in Canada, having taken over part of the Canadian Rumeley Building in Toronto. It is reported that later the company intends to manufacture the clothes-washing machine at the same plant. It is also reported that the shortage of motors is holding back the Canadian output.

INCREASE IN CAPITAL ISSUES OF ELECTRICAL COMPANIES IN THE UNITED KINGDOM.—To provide for important developments many electrical companies have recently made or contemplate new issues of capital. The Brush Electrical Engineering Company, Ltd., will soon issue 339,512 ordinary shares of £1 each at par. This company is building an entirely new factory at Loughborough for the manufacture of "Ljunstrom" turbines and is making extensive additions to its present factories. The Midland Electric Corporation for Power Distribution, Ltd., is making an issue of 250,000 ordinary shares of £1 each at par; the Calcutta Elec-

tric Supply Corporation, Ltd., is inviting applications for £500,000 convertible debentures; the directors of Vickers, Ltd., are also inviting applications for £1,500,000 seven-year notes, and the Fuller's United Electric Works, Ltd., have issued £200,000 five-year notes. The appointment of the Electricity Commissioners and the associated changes in the electrical legislation are generally regarded as a guarantee that there will be a great demand for electrical apparatus and equipment for many years to come.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A firm in Switzerland (No. 33,551) desires to secure the representation of firms for the introduction into that country of small boats, driven by electricity, of a capacity of five to ten persons, for sporting purposes; also motors and batteries for such boats.

An agency association in the Netherlands (No. 33,554) desires to get in touch with manufacturers who are not represented in that country, with a view of securing exclusive agencies for the sale of all kinds of electric cable and wire, including electrolytic copper wire for overhead feeding lines, etc.

An importer in Italy (No. 33,564) desires to purchase a large quantity of small electric lamps from 105 volts to 110 volts with filaments.

Trade Publications

ELECTRICAL SUPPLIES.—The Frank H. Stewart Company, 37-39 North Seventh Street, Philadelphia, dealer in electrical supplies, has issued general catalog No. 22. The book is cloth-bound and contains 667 pages, covering electrical apparatus handled by the company.

HEAT-TREATING CONTAINERS.—The Driver-Harris Company, Harrison, N. J., is distributing bulletin N-2 describing its cast "Nichrome" heat-treating containers, and bulletin R-21, entitled "Alloys for Electrical Resistance," covering practical uses of the D-H alloys, manufactured by the company.

ADJUSTABLE-SPEED MOTORS.—The General Electric Company, Schenectady, N. Y., has issued a second edition of bulletin No. 41,921 A, superseding bulletin No. 41,021 and describing the latest design of RF, form A, direct-current, adjustable-speed motors, rated from 2 to 50 intermittent horsepower.

DEFLECTION POTENTIOMETER.—A second edition of bulletin No. 46,112, describing the deflection potentiometer, has been issued by the General Electric Company, Schnectady, N. Y.

STREET-LIGHTING UNITS.—Bulletin No. 43,503B, superseding bulletin No. 43,503A, entitled "Novalux," has been issued by the General Electric Company, Schenectady, in which it describes and illustrates the Novalux ornamental street-lighting units.

INDEXES.—The General Electric Company, Schenectady, N. Y., has issued indexes to its descriptive bulletins and sheets and supply-parts bulletins, both dated July, 1920.

SCIENTIFIC ILLUMINATION. — The "Holophane Datalog" is the title of a 128-page illustrated handbook published by the Holophane Glass Company, 340 Madison Avenue, New York City, which is a combined data book and catalog. There are also forty-six reproductions of night photographs showing actual installations of illuminating systems.

New Incorporations

THE TAYLORSVILLE (GA.) LIGHT & POWER COMPANY has been incorporated with a capital stock of $8,000 by William M. Dorsey, C. D. Shaw and A. R. McGinnis.

THE TOWNVILLE (S. C.) WATER, LIGHT & POWER COMPANY has been organized to establish an electric plant. Dr. Webb is president and E. B. Farmer secretary.

THE RIDGELEY (W. VA.) LIGHT & POWER COMPANY has been incorporated by James T. Vandegrift, Howard R. Knight and Elmer E. Biggs. The company is capitalized at $25,000 and proposes to furnish electricity for lamps and motors in Ridgeley.

THE RUDOLPH (OHIO) LIGHT & POWER COMPANY has been incorporated with a capital stock of $10,000 by W. J. Shuler, F. T. Hillabrand, J. H. Moore, H. Richardson and F. Mercer.

THE VIOLET (LA.) ICE & ELECTRIC COMPANY has been organized with a capital stock of $50,000 to install an electric plant. E. Vaughn is president and T. Vaughn secretary and treasurer.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PORTLAND, ME.—St. Joseph's Convent, Deering, contemplates the erection of a convent building at Deering, to cost about $300,000. Electric lighting will be installed. O'Connell & Show, 18 Boylston Street, Boston, Mass., are architects.

ATTLEBORO, MASS.—A petition from the residents of Cherry Street for the installation of electric lights has been referred to the street lighting committee.

FALL RIVER, MASS.—The American Printing Company contemplates improvements to its plant including the erection of a power house to cost about $46,000.

MILLBURY, MASS.—A town meeting was held recently for the purpose of considering appropriation for local improvements including $1,250 for the installation of a new fire alarm system.

MIDDLETOWN, CONN.—The Goodyear Rubber Company, 114 Church Street, has plans under way for the construction of a new power plant, 30 ft. x 40 ft. Buck & Sheldon, Inc., 60 Prospect Street, Hartford, are architects and engineers.

Middle Atlantic States

CANANDAIGUA, N. Y.—A meeting of the common council, representatives of the Rochester Gas & Electric Company and of the O'Connell Electric Construction Company has been held for the discussion of a proposition to install a modern street-lighting system in this city.

CAMDEN, N. J.—Contract has been awarded to the White Construction Company, 95 Madison Avenue, New York, N. Y., by the Victor Talking Machine Company, Front and Cooper Streets, for the erection of a power house, 53 ft. x 200 ft.

GLASSBORO, N. J.—Bids will be received by Francis H. Bent, state architect, 142 West State Street, Trenton, until Sept. 14 for electrical work to be done on the State Normal School at Glassboro. Specifications may be obtained on application to the Department of Architecture at the Trenton address.

NEWARK, N. J.—Contract will soon be awarded by the Merchants' National Bank, 770 Broad Street, for the erection of an office building, 100 ft. x 200 ft. Electric lighting equipment will be installed. J. H. & W. C. Ely, Firemen's Trust Building, are architects.

NEWARK, N. J.—John Ebersberger, operating a cooperage at Paris Street and Wilson Avenue, contemplates the erection of a new power house on Passaic Avenue and Blanchard Street.

NEWARK, N. J.—The Celluloid Company, 24 Niagara Street, has plans under way for improvements to its power house including new brick stack to cost about $15,000.

NEWARK, N. J.—The City Commission is considering the establishment of a municipal electric light and power plant to be operated in conjunction with the city waterworks. It is proposed to submit the proposition with a bond issue to the voters at the next regular election.

TRENTON, N. J.—The Mutual Pottery Company, Clinton Avenue, has awarded contract to Stone & Webster, 120 Broadway, New York, N. Y., for the construction of a pottery plant and power house to cost about $500,000.

WEST HOBOKEN, N. J.—The erection of a factory at Homestead is contemplated by the American Chocolate Products Company, 206 Broadway, New York, N. Y., to cost about $350,000. Electric light and power equipment will be installed. Andrews, Tower & Lavalee, 33 Lyman Street, Springfield, Mass., are engineers and architects.

WEST ORANGE, N. J.—The Board of Education contemplates the erection of a school to be known as the Gregory School at a cost of about $450,000. Electric light equipment will be installed. Guilbert & Betelle, 2 Lombardi Street, Newark, are architects.

CLEARFIELD, PA.—Application will be made for the incorporation of the Union Township Clearfield Electric Company, for the purpose of supplying light, heat and power to the residents of Union Township.

BALTIMORE, MD.—Bids will be received by the Board of Awards, care of City Register, until Sept. 8 for furnishing, delivering and installing fire alarm telegraph central office equipment for fire department, including receiving and sending apparatus, batteries, switchboards, etc., to cost about $90,000.

BALTIMORE, MD.—The water department has an appropriation of $45,000 available for the installation of a new pumping unit at the eastern pumping station.

BALTIMORE, MD.—Contract has been awarded to the McLain Contracting Company, Fidelity Building by the Consolidated Gas, Electric Light & Power Co., Lexington Building, for the construction of a substation at Port Covington to cost about $80,000.

BALTIMORE, MD.—The Coca-Cola Company, S. L. Willard, resident manager, Pratt Street and Market Place, has awarded the contract to the Arthur Tufts Company, Chandler Annex, Atlanta, Ga., Louis Wilcox, 921 Munsey Building, Baltimore, local manager, for the erection of a Coca-Cola factory and cooperage plant, to cost about $1,250,000. Electric light equipment and elevators will be installed.

GALAX, VA.—J. K. Caldwell of Galax, and others, contemplate the erection of a hydro-electric plant at Pinnacles of Dan to develop 10,000 hp. The cost of the project is estimated at about $500,000.

North Central States

DETROIT, MICH.—The Fort Shelby Garage, care of John Gillespie, Fort Shelby Hotel, contemplates the erection of a garage 130 ft. x 150 ft. Wiring for electric light and motors will be installed. Albert Kahn, Marquette Building, is architect.

DETROIT, MICH.—The City Council has ordered estimates to be prepared for the erection of a memorial building, 250 ft. x 600 ft. Complete electrical equipment will be installed. John A. Kronk, City Hall, is in charge.

DETROIT, MICH.—The Temple Beth El, 580 Woodward Avenue, contemplates the erection of a temple to cost about $1,000,000. Electric lighting equipment will be installed. Albert Kahn, Marquette Building, is architect and engineer.

OWOSSO, MICH.—An electric lighting system for the boulevards will be installed at a cost of about $30,000. Plans call for furnishing and installing 178 mono-light standards, 23,000 ft. of 5,000-volt armored cable, transformers, switchboards, etc. John C. Parker, Ann Arbor, is engineer.

CAREY, OHIO.—The City Council contemplates the reconstruction of its distribution system which will involve either the construction of a power plant or the erection of transmission lines, to cost about $90,000. Froehlich & Emery, Second National Bank Building, Toledo, are engineers.

CLEVELAND, OHIO.—The Babies' and Children's Hospital, care of Abram Garfield, architect, National City Building, contemplates the erection of a children's hospital to cost about $500,000. Plans include a power house, electric elevators, etc.

CLEVELAND, OHIO.—The Board of Education, care of F. Hogan, Sixth Street and Rockwell Avenue, contemplates the erection of a school for crippled children to cost about $500,000. Electric light equipment will be installed.

IRONTON, OHIO.—The Kelly Nail & Iron Company, Monroe Street, plans to erect a power house, 40 ft. x 60 ft., by day labor. Ralph Murray, Masonic Temple Building, is architect.

JACKSON, OHIO.—Bids will be received by C. O. Brown, clerk of the Board of Education, until Sept. 20 for furnishing material and labor for the construction of an electrical service line in Jackson Township Rural School District.

MASSILLON, OHIO.—Work will soon be started on the construction of a new plant for the Lewis Electric Company, capitalized at $100,000, for the manufacture of the Lewis safety entrance switch.

WARREN, OHIO.—The General Fire Extinguisher Company, Dana and Page Avenues, has plans under way for the construction of a power house addition, 30 ft. x 75 ft. H. M. Lane, 701 Owen Building, Detroit, Mich., is engineer.

INDIANAPOLIS, IND.—Contract has been awarded to the J. G. Karstedt Construction Company, Lemcke Building, by the Methodist Hospital for an addition to the institution to cost about $300,000. Wiring for the entire building and fixtures will be installed.

INDIANAPOLIS, IND.—The Republic Creosoting Company, 1614 Merchants' Bank Building, contemplates the erection of a power plant at its works. C. Brossman, 1503 Merchants' Bank Building, is engineer.

INDIANAPOLIS, IND.—Contract has been awarded to the State Construction Company, Pythian Building, by the W. Steinhart Company, Eleventh and Meridian Streets, for the erection of a five-story service station to cost about $400,000. Electric light equipment will be installed.

EAST ST. LOUIS, ILL.—The Eagle Pitcher Lead Company, Railway Exchange Building, St. Louis, Mo., has awarded the contract to the Wimmer Contracting Company, Victoria Building, St. Louis, Mo., for the erection of a lead products factory to cost about $600,000. A power plant will be installed.

EMBARRASS, WIS.—The Matteson Light & Power Company of Matteson has been recently incorporated with a capital stock of $15,000 for the purpose of generating and distributing electric light and power.

LONE ROCK, WIS.—A site between Lone Rock and Gotham is being surveyed for the construction of a dam for power purposes. A. H. Fries is city clerk.

BEMIDJI, MINN.—Contract has been awarded to the Naylor Electric Company for the installation of an ornamental street-lighting system, at $29,883.46. Plans include 126 posts and 440-cp. series lamps.

KINNEY, MINN.—The City Council contemplates the erection of an ornamental street-lighting system on Main Street. E. L. May is city clerk.

ST. LOUIS, MO.—The Bowen Motor Railway Company, Title Guaranty Building, contemplates the erection of a proposed factory and power house to cost about $385,000. O. J. Popp, Odd Fellows' Building, is architect.

ST. LOUIS, MO.—Bids will be received by the Lowenstein Brothers Real Estate Company, Wainwright Building, until Sept. 15 for the erection of an office building to cost about $750,000. Electric light wiring and special equipment will be installed.

ST. LOUIS, MO.—The Bridge & Beach Manufacturing Company, 503 South First Street, has awarded the contract to the Fruin Colnon Contracting Company, Merchants' Laclede Building, for the erection of a factory and power plant to cost about $800,000.

ST. LOUIS, MO.—Contract has been awarded to the John Hill Construction Company, Syndicate Trust Building, by the Boyd Clothing Company, Seventh and Olive Streets, for the construction of a mercantile building to cost about $400,000. Wiring for electric light and power will be installed.

CANDON, N. D.—The city officials contemplate the purchase of an electric lighting plant. W. A. Martin is manager of city light committee.

SCOTTSBLUFF, NEB.—The City Council has been petitioned to make extension to the street-lighting system in the residential district.

WAKEENEY, KAN.—Bids will be received by the city clerk until Sept. 17 for furnishing labor for the erection of a power plant and providing all necessary equipment, including generators, exciters, etc. Black & Veach, Mutual Building, Kansas City, Mo., are engineers.

Southern States

JACKSONVILLE, FLA.—The Ford Motor Company, Highland Park, Mich., will soon award the contract for the erection of a service station. Separate light and power systems requiring conduits, electric motors, etc., will be installed. Albert Kahn, Marquette Building, Detroit, Mich., is architect.

MOBILE, ALA.—The Kelly Drydock & Shipbuilding Company, Commerce Street, contemplates the erection of a machine shop, power house, etc., to cost about $150,000. E. L. Whitney is president.

ROGERSVILLE, ALA.—It is reported that the municipal electric light plant has been destroyed by fire, causing a loss of $5,000.

RAYVILLE, LA.—An election will be held on Sept. 21 for the purpose of submitting to the voters an issue of $50,000 in bonds for improvements to the waterworks, electric light and power plants.

EUREKA SPRINGS, ARK.—A special improvements district has been created by the city commissioner for the installation of a street-lighting system.

PURCELL, OKLA.—An election will be held soon for the purpose of submitting to the voters an issue of $382,000 in bonds for municipal work, including improvements to the electric light plant to cost about $18,000. Johnson & Benham, Firestone Building, Kansas City, Mo., are engineers.

BEAUMONT, TEX.—An electric crane will be installed by the Beaumont Iron Works in its proposed new foundry and pattern shop.

CORSICANA, TEX.—The Chanway Mattress Company contemplates the installation of electrically driven machinery for the manufacture of mattresses, to cost about $30,000. C. W. Rogers is president.

DALLAS, TEX.—The Rick Warehouse & Stores Company contemplates the erection of an exposition building and warehouses to cost about $1,000,000. Electrical freight-carrying devices will be installed.

EL PASO, TEX.—The Southern Baptist Sanatorium contemplates the erection of a power plant. H. F. Vermillion is superintendent.

Pacific and Mountain States

BANDON, ORE.—The city officials have filed preliminary application with the state engineer for permission to divert 25 sec.-ft. water from Wilson River for power purposes. Proposed plans include the erection of a lighting plant to develop 1,000 kw. and the construction of an 18-mile transmission line.

SALEM, ORE.—M. J. Anderson of Portland contemplates extensive development of power on the south fork of the Coquille River. The cost of the project is estimated at about $750,000.

SALEM, ORE.—Application has been made by R. J. Hendricks of Salem for permission to construct a reservoir and divert water from the Trask River for power purpses.

TOLEDO, ORE.—Application has been filed with the state engineer by the city officials for permission to divert 300 sec.-ft. water from the Siletz River for power purposes. Plans include the erection of a dam. The total cost is estimated at about $250,000.

HOLLYWOOD, CAL.—Hunt & Burns, architects, Laughlin Building, Los Angeles, have plans under way for the construction of a hospital to include a power house at Highland and Cahuenga Avenues.

SAN DIEGO, CAL.—The Bureau of Yards and Docks, Navy Department, Washington, D. C., contemplates the installation of a fire alarm system at San Diego.

BRIGHAM, UTAH.—At an election to be held on Sept. 10, an issue of $250,000 in bonds will be submitted to the voters for the erection of an addition to the municipal electric plant. C. O. Roskelley is engineer.

SALT LAKE CITY, UTAH.—Application has been filed with the state engineer by R. H. Peale of Salt Lake City for permission to divert water from the San Rafael River for electric light and power purposes. Plans include the erection of a power house and dam.

MILES CITY, MONT.—A corporation to be capitalized at $500,000 is being promoted by the Yellowstone Irrigation Company for irrigation and also for power purposes.

Canada

FORT ERIE, ONT.—The submission of a by-law covering an appropriation of $10,000 for changes to the electric system, improvements to the pump house, etc., is under consideration by the Fort Erie Council.

KINCARDINE, ONT.—Work will soon be started on remodelling the present electric distribution system in this town. Wiring, transformers and general equipment such as switches, poles, lighting equipment will be required. E. McLeod, Kincardine, is superintendent.

LONDON, ONT.—Contract will soon be awarded by the Grand Trunk Railway Company for lighting its entire local yards by electricity, including all switch lamps, signals and other lights requiring special conduits, switches and all general wiring and equipment. C. Forrester is superintendent.

LONDON, ONT.—The Benson Hines Hotel Company has awarded the contract to George A. Fuller Company, 45 St. Alexander Street, for the erection of a hotel to cost about $1,500,000. Electric lighting system will be installed.

LONDON, ONT.—The Daughters of the Empire will soon award the contract for the erection of a children's hospital to cost about $250,000. Electric lighting equipment, interphone system, motors, triplex pumps, etc., will be installed. Watt & Blackwell, Bank of Toronto, are engineers.

LONDON, ONT.—The Utilities Commissioners contemplate extensions to the waterworks, including the installation of one 500,000 Imp. gal. electrically driven pump. E. V. Buchanan, Hydro Offices, London, is general manager.

NEWBURY, ONT.—At an election to be held on Sept. 14 a by-law authorizing the construction of an electric light and power distribution system to cost about $10,000 will be submitted to the ratepayers of the town. Charles Tucker of Newbury, is engineer.

NEW TORONTO, ONT.—Bids will soon be received by E. A. James Company, engineers, 36 Toronto Street, Toronto, for two three-stage electrically-driven centrifugal pumps under a head of 329 ft.

TORONTO, ONT.—Bids will be received by Mayor T. L. Church, room 12, City Hall, until Sept. 14, for two 300,000 Imp. gal. per day, vertical centrifugal pumps with electric motors against 320-ft. head.

TORONTO, ONT.—Contract has been awarded to J. B. Nicholson & Company, 36 Toronto Street, at $35,000, by the J. A. Harrison Coal Company, Ltd., 57 Brock Avenue, for the erection of a coal elevating and cold storage plant. Electrically driven machinery will be installed.

(Issued Aug. 17, 1920)

1,349,979. ELECTRIC DARNING BALL; Lucinda Ritter, Riverside, Cal. App. filed April 10, 1920. Illuminated by flashlamp.

1,349,995. CONTROLLING SYSTEM FOR METAL-WORKING MACHINES; Edward V. Wurts, Newark, N. J. App. filed Sept. 24, 1917. For machines punching structural shapes.

1,349,999. PROCESS OF AMALGAMATING STEEL BODIES; Clarence W. Balke, Highland Park, Ill. App. filed May 31, 1918. For amalgamating the inner surfaces of the hollow stems of mercury-cooled valves.

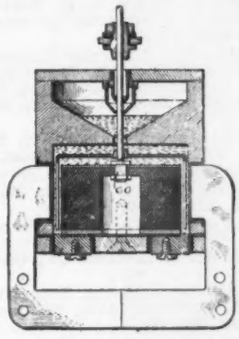
1,350,003. ELECTRIC CONTROLLER; Emil J. Carroll, Cincinnati, Ohio. App. filed Nov. 23, 1916. For controlling a number of machines.

1,350,010. SELF-PROTECTING CONDENSER; William Dubilier, New York, N. Y. App. filed Jan. 16, 1918. Plates melt away from hole when pierced or ruptured.

1,350,022. RADIATOR AND PROCESS OF AND APPARATUS FOR PRODUCING SAME; George B. Jackson, Chicago, Ill. App. filed April 23, 1917. Unequally deposits metal, thus producing a one-piece seamless radiator.

1,350,038. STREET-CAR ANNUNCIATOR; James L. Scroggins, Bennington, Okla. App. filed Sept. 16, 1919. Automatically indicates consecutive stops as car proceeds.

1,350,077. VALVE-OPERATING MECHANISM; Warren P. Loudon, Niagara Falls, N. Y. App. filed March 25, 1918. For operating the radiator valves of railway cars.



1,350,485. Graphic Recording Instrument

1,350,100. RADIO-SIGNALING; John L. Hogan, Jr., Brooklyn, N. Y. App. filed Nov. 27, 1916. Uses two antennas or absorbing systems equally affected by disturbances, whereby the effects of disturbances neutralize each other, but differently affected by incoming signal impulses.

1,350,170. ARC-LAMP SYSTEM; Thomas J. Murphy, Rochester, N. Y. App. filed Jan. 12, 1917. For starting arcs in lamps having tungsten terminals in a neutral gas.

1,350,174. AUTOMATIC RECORDING MECHANISM; Harry Y. Norwood and Frederick W. Stalker, Rochester, N. Y. App. filed May 20, 1916. Records temperatures of several points.

1,350,188. AUTOMATIC BURGLAR ALARM; Franklin A. Terry, San Francisco, Cal. App. filed July 9, 1917. Phonograph calls alarm over telephone.

1,350,193. ATTACHMENT FOR CABLE RECORDERS; Frederick S. Whitney, New York, N. Y. App. filed March 25, 1918. Controls tape-punching devices.

1,350,214. DEVICE FOR REGULATING AND MAINTAINING CONSTANT THE SPEED OF MOTORS; Richard Eisenmann, Berlin, Germany. App. filed Dec. 29, 1914. Automatic brake prevents high speed.

1,350,243. TROLLEY CONTROL; Mike Shukites, Jr., Johnston City, Ill. App. filed Feb. 27, 1918. Trolley drops if it leaves wire.

1,350,279. ADJUSTABLE CONDENSER; Paul J. Howe, Ridgewood, N. J. App. filed Feb. 7, 1918. Rotary switch.

1,350,280. ADJUSTABLE RHEOSTAT; Paul J. Howe, Ridgewood, N. J. App. filed Feb. 7, 1918. Rotary switch.

(Patents issued Aug. 24, 1920)

1,350,300. INTERRUPTER-SPARK-SUPRESSION METHOD AND DEVICE; William J. Crumpton, Evanston, Ill. App. filed April 26, 1917. Condenser in shunt is disconnected and discharged before contacts reclose.

1,350,317. ALLOY FOR ELECTRIC WELDING; Edward J. Kingsbury, New York, N. Y. App. filed Nov. 20, 1919. Containing iron, carbon, manganese, vanadium, phosphorus, sulphur and silicon.

1,350,328. SWITCHBOARD AND THE LIKE; Frederick A. Muschenheim and Frederick W. Blasdale, New York, N. Y. App. filed Jan. 12, 1918. Hotel room rack.

Record of Electrical Patents

Notes on United States Patents

1,350,334. METHOD OF AND MEANS FOR ESTABLISHING ELECTRICAL CIRCUITS; Albert A. Radtke, Chicago, Ill. App. filed Sept. 8, 1919. Pointer of galvanometer causes spark to jump across distributor.

1,350,345. TELEMETRIC DEVICE; Harry L. Tanner, Brooklyn, N. Y. App. filed June 7, 1918. Repeats at a distance the movements of an indicator.

1,350,355. RECORDING APPARATUS FOR RAILWAY SIGNALS; Leon S. Brach, New York, N. Y. App. filed March 6, 1913. Indicates time and duration of a signal.

1,350,369. CIRCUIT-CONTROLLING MECHANISM; Achilles de Khotinsky, Chicago, Ill. App. filed April 29, 1916. For use with thermostatically-controlled electric heating appliances.

1,350,382. ELECTRIC CONTROL SYSTEM; Percy R. Owens, Mount Kisco, N. Y. App. filed Aug. 3, 1918. For regulating clocks.

1,350,423. ELECTRIC-LAMP SUPPORT; Albert C. Runkel, Milwaukee, Wis. App. filed Sept. 5, 1918. Movable.

1,350,424. POWER-TRANSMISSION SYSTEM; Jacob Schurch, Holtville, Cal. App. filed Jan. 12, 1916. For motor vehicle.

1,350,426. ELECTRICAL CONTROL SYSTEM FOR AUTOMOBILES; Wendelin P. Seng, Chicago, Ill. App. filed Feb. 24, 1917. Controls lights and locks magnet.

1,350,437. ELECTRIC SYSTEM; Mark C. Cosgray, Sandusky, Ohio. App. filed Jan. 30, 1919. Charging of batteries.

1,350,446. SPEED-REGULATING APPARATUS; Valere A. Flynn, St. Louis, Mo. App. filed May 27, 1918. For internal combustion engines.

1,350,447. SPEED-REGULATING APPARATUS; Valere A. Flynn, St. Louis, Mo. App. filed May 27, 1918. For internal combustion engines.

1,350,485. GRAPHIC RECORDING INSTRUMENT; Jacob W. Bard and Otis White, Springfield, Ill. App. filed Oct. 14, 1916. Mercury supported element.

1,350,536. TELEPHONE-EXCHANGE SYSTEM; Joseph L. Wright, Cleveland, Ohio. App. filed Feb. 26, 1912. Phonograph asks subscriber for number.

1,350,540. FEED MECHANISM FOR PLANERS; Harold L. Blood, Plainfield, N. J. App. filed Oct. 19, 1916. Controls driving motor.

1,350,557. WELDING CONDENSER PARTS; Ralph D. Mershon, New York, N. Y. App. filed Dec. 8, 1919. For welding aluminum with other metals.

1,350,561. STORAGE BATTERY; Irvine M. Noble and Walter E. Gossling, Indianapolis, Ind. App. filed Aug. 26, 1918. More compact battery.

1,350,572. WELDING APPARATUS; Herbert M. Smith, Great Barrington, Mass. App. filed Sept. 30, 1918. For line welding of tubes.

1,350,586. ELECTRIC HEATER; Charles A. Xardell, Utica, N. Y. App. filed April 13, 1920. Self-regulating.

1,350,594. TELEPHONE-RECEIVER; William W. Dean, Rochester, N. Y. App. filed May 10, 1916. Simplified construction.

1,350,631. ELECTRIC HEATER; Charles A. Xardell, Utica, N. Y. App. filed Jan. 8, 1920. Resistance type.

1,350,695. RADIOTELEGRAPHY; Ralph R. Beal, Palo Alto, Cal. App. filed Oct. 8, 1917. Using arc transmitter.

1,350,703. STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINE; Alexander Churchward, New York, N. Y. App. filed May 28, 1919. Electric starter applied to flywheel.

1,350,714. PROCESS OF TREATING METALS AND ALLOYS; Charles Bruce Foley, Brooklyn, N. Y. App. filed June 29, 1917. Temperature in induction furnace controlled by static head of metal above heated portion.

1,350,734. MEANS FOR ELECTRICALLY MARKING UPON METALS; William S. Overlin, Portland, Oregon. App. filed Nov. 24, 1919. Vibrating pen.

1,350,737. TELEPHONE-OPERATING DEVICE; William H. Riess, Cincinnati, Ohio. App. filed March 2, 1917. Receiver hook electrically operated from exchange.

1,350,752. HIGH-FREQUENCY SIGNALING; Hendrik Johannes van der Bijl, New York, N. Y. App. filed Aug. 21, 1915. Modulation of waves.

1,350,790. TELEGRAPHY; Patrick B. Delany, South Orange, N. J. App. filed June 12, 1918. Wets tape with solution for reception of messages.

1,350,801. RADIOTELEGRAPHY; John Hays Hammond, Jr., Gloucester, Mass. App. filed May 28, 1913. Transmitting apparatus for selective receiving.

1,350,828. HOLLOW PROJECTILE-SHELL OF SHEET METAL; Thomas E. Murray, Jr., and Joseph B. Murray, Brooklyn, N. Y. App. filed July 15, 1918. Halves welded together electrically.

1,350,833. PROCESS OF ELECTRICALLY WELDING TRANSVERSE PLATES TO TUBES; Thomas E. Murray, Brooklyn, N. Y. App. filed Dec. 16, 1919. Toothed holes in plate.

1,350,837. PORTABLE ELECTRIC LIGHT; Frank Rampp, New York, N. Y. App. filed Jan. 25, 1918. Improved flashlamp switch.

1,350,856. EXPANSION-JOINT FOR ELECTRIC-CURRENT-COLLECTOR BARS; Elmer A. Davis, Harvey, Ill. App. filed March 24, 1919. Flexible.

1,350,867. ELECTRIC FLATIRON; Henry Kocourek, Chicago, Ill. App. filed Aug. 21, 1919. Guard for plug.

1,350,875. MEASURED-SERVICE TELEPHONE SYSTEM; Tablot G. Martin, Chicago, Ill. App. filed Dec. 24, 1917. Registers calls when lines are busy.

1,350,734. Means for Electrically Marking Upon Metals

1,350,876. ELECTRIC FURNACE; Walter S. Mayer and Walter C. Kennedy, New Brighton, Pa. App. filed Dec. 15, 1916. Plurality of resistance units.

1,350,877. METHOD OF OXIDIZING MATERIALS IN ELECTRIC FURNACES; Walter S. Mayer and Walter C. Kennedy, New Brighton, Pa. App. filed March 17, 1917. Controls air admission.

1,350,882. AUTOMATIC TELEPHONE SYSTEM; Winfred T. Powell, Chicago, Ill. App. filed April 14, 1917. For two classes of service.

1,350,895. HEATING DEVICE AND CONTROL THEREFOR; Stuart Thomson, Washington, D. C. App. filed Feb. 26, 1918. Using auto transformer.

1,350,899. ELECTRICAL SYSTEM OF POWER TRANSMISSION; Magnus Unger, Pittsfield, Mass. App. filed Nov. 15, 1918. Regulates load power factor.

1,350,907. METHOD FOR FORMING CONDUCTING-SEALS FOR INCANDESCENT-LAMP BULBS OR THE LIKE; Teizo Yanai, Tokyo, Japan. App. filed Sept. 30, 1916. Copper oxide forms seal.

1,350,910. ELECTRIC HEATING UNIT; Charles C. Abbott, Pittsfield, Mass. App. filed June 20, 1918. Using sheathed wire.

1,350,911. WIRELESS SIGNALING SYSTEM; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 20, 1917. Receiving apparatus neutralizes waves from the same station.

1,350,912. RADIO RECEIVING SYSTEM; Ernst F. W. Alexanderson, Schenectady, N. Y. App. filed Aug. 25, 1917. Receives messages at same time that messages are being transmitted from a station near-by.

1,350,920. ELECTRICAL SYSTEM OF POWER TRANSMISSION; James R. Craighead and Henry R. Summerhayes, Schenectady, N. Y. App. filed April 17, 1919. Load, power factor or both indicated.

1,350,921. POWER-LIMITING SYSTEM; James R. Craighead, Schenectady, N. Y. App. filed Jan. 26, 1920. Maintains voltage on regenerative-braking railway systems.

1,350,922. HIGH-TENSION TELEPHONE SYSTEM; Frank C. Doble, Winchester, Mass. App. filed July 30, 1919. Insulated for high voltage.

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